CUK-H06658-146-RP276

NATURE, FEBRUARY 1, 1941

NATURE

A WEEKLY JOURNAL OF SCIENCE

"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

146

Volume 146

JULY 6, 1940, to DECEMBER 28, 1940

LONDON
MACMILLAN AND CO., LTD.
NEW YORK: THE MACMILLAN COMPANY

DATES AND PAGINATION OF WEEKLY ISSUES

Serial No.	Date of Issue		Pagination
3688	July	6	1–38
3689	,,	13	39–72
3690	,,	20	73–106
3691	,,	27	107–140
3692	August	3	141–174
3693	,,	10	175–208
3694	,,	17	209–242
3695	,,	24	243–276
3696	,,	31	277–310
3697	September	7	311–340
3698	,,	14	341–374
3699	,,	21	375–408
3700	,,	28	409–438
3701	October	5	439–468
3702	,,	12	469–498
3703	,,	19	499–528
3704	,,	26	529–566
3705	November	2	567–596
3706	,,	9	597–626
3707	,,	16	627–660
3708	,,	23	661–694
3709	,,	30	695–724
3710	December	7	725–754
3711	,,	14	755–784
3712	,,	21	785–814
3713	,,	28	815–844

Rp R2H6

INDEX

NAME INDEX

Abbot (Dr. C. G.), Periodicities in Solar Variation reflected in Weather, 564; Utilization of Sun Power, 744
Abraham (Dr. E. P.), and Dr. E. Chain, An Enzyme from Bacteria able to Destroy Penicillin, 837
Adam (Dr. L.), Primitive Art: Past and Future, 519
Adam (M. G.), Variation of Faint Fraunhofer Lines, 780
Adam (Prof. N. K.), Water and All its Properties (*Review*), 145
Adams (R.), and L. J. Dankert, Restricted Rotation in Arylamines, 690
Adams (S. C.), [G. N. Tyson and], Configurations of Quadricovalent Complexes, 103
Adamson (A. M.), New Termite Intercastes, 655
Adler (Dr. J.), [Dr. J. M. Robson and], Site of Action of Œstrogens, 60
Aitken (Dr. A. C.), Probability and Relative Frequency (*Review*), 114; Determinants and Matrices (*Review*), 665
Alexander (A. E.), Pearl Formed Around a Rotifer, 370
Alexander (Prof. W. P.), awarded the Cornelius Amory Pugsley medal of the Buffalo Museum of Science, 161
Allen (C. W.), Spectrum of bright Chromospheric Eruptions, 749
Allen (Prof. H. S.), The Search for Truth, 637; Dr. F. L. Arnot, 832
Allen (H. W.), J. K. Holloway and G. J. Haeussler, Parasites of the Oriental Fruit Moth, 719
Allen (W.), [R. Fitzmaurice and], Sound Transmission in Buildings: Practical Notes for Architects and Builders (*Review*), 417
Alter (G.), A Photographic Survey of Galactic Clusters, 69
Alvarez (Dr. J. G.), Health Conditions in Venezuela, 836
Amery (L. S.), Indian Art and Religion, 680
Ananthapadmanabhan (T. S.), [Prof. K. S. Krishnan, S. L. Chorghade and], Dimorphism of Diphenyl Octatetraene Crystals, 333
Anderson (C. A.), Crystallization of Olivine-basalt, 236
Anderson (E. G.), and R. A. Brink, Cytogenetics of Maize, 270
Anderson (Prof. E. H.), and Prof. G. T. Schwenning, The Science of Productive Organization (*Review*), 574
Anderson (H. V.), [J. S. Long and], Chemical Calculations. Fourth Edition (*Review*), 545
Angström and Jacobson, Temperature Measurements in Vänern and Götaälv, 749
Appleton (Prof. E. V.), Sir J. J. Thomson, 353
Arakawa (Dr. H.), [Dr. Y. Nishina, Y. Sekido, H. Simamura and], Cosmic Ray Intensities in relation to Cyclones and Anticyclones, 95
Arber (Dr. Agnes), An Aztec Herbal, 81
Arber (Muriel A.), Outline of South-West England in relation to Wave-attack, 27
Archenhold (G. H. A.), Distribution of Sunspots over the Sun's Disk, 780
Arctowski (H.), Solar Faculæ and Solar Constant Variations, 495
Argand (Prof. E.), [death], 740
Argument (C.), [C. W. Gibby and], Adsorption at a Liquid Interface, 203
Arkhangelsky (Prof. A. D.), [obituary article], 395
Armstrong (Dr. E. F.), Progress in Biochemistry (*Review*), 383; Hydrocarbons (Review), 507; The Science of Plant Protection (*Review*), 569; History of Laboratory Apparatus (*Review*), 604
Arnold [Kerr, Shannon and], Vibration of Propeller Blades, 843
Arnot (Dr. F. L.), [obituary article], 832
Aronson (Dr. J. D.), Disease among Natives of Alaska, 298
Arrowsmith and Wolfe, Use of Refrigeration to Delay Age-hardening, 495
Arthur (Prof. A.), Lecture Demonstrations in General Chemistry (*Review*), 666
Ashcraft (G.), Barnacles attached to Birds, 561
Ashworth (late Prof. J. H.), Bronze memorial plaque to, 161
Aslin (Miss), Library Catalogue of Printed Books and Pamphlets on Agriculture published between 1471 and 1840. Second edition, 92
Astbury (Dr. W. T.), Florence O. Bell and C. S. Hanes, X-Ray comparison of Natural and Synthetic Starch, 558
Aston (Dr. F. W.), Sir J. J. Thomson, 355
Atkinson (R. d'E.), Accretion and Stellar Energy, 271
Austen (A. E. W.), and S. Whitehead, Electric Strength of Some Solid Dielectrics, 595
Austin (R. G.), Aids to Physical Chemistry (*Review*), 544

Babcock (E. B.), [G. L. Stebbins and], Apomixis in Crepis, 34
Bacharach (A. L.), Vitamin-free Diets for Animal Experiments, 28; [J. Madinaveitia, Prof. J. A. Todd, M. R. A. Chance and], Mucolytic Activity of Diffusing Factor Preparations, 197
Bagshawe (T. Wyatt), Two Men in the Antarctic: an Expedition to Graham Land, 1920–1922 (*Review*), 282
Bailey (Dr. E. B.), Submarine Canyons, 493
Baillie (Sir James), [obituary article], 54; bequest to Leeds University, 617
Baker (A. H.), and S. R. Finn, Hydration of Carbon Dioxide and its Influence on Germicidal Activity of Hypochlorite Aerosols, 747
Baker (H. H.), [death], 678
Baker (T. Thorne), Electrical Photo-Engraving, 372
Baldacci (Prof. E.), Taxonomy of the Actinomycetes, 170
Baldwin (Dr. E.), [D. J. Bell and], *l*-Galactose as a component of a Polysaccharide of Animal Origin, 559
Balfe (M. P.), M. Irwin and Dr. J. Kenyon, Complex Rotatory Dispersion of Optically Active Tetrahydrofuryl-2-carbinol, 686
Bamford (late F.), Poisons: their Isolation and Identification (*Review*), 414
Banta (A. M.), [H. H. Durham and], Colchicine Treatment of Daphnia, 170
Barber (H. N.), and J. R. Price, Nature of the Feulgen Reaction with Nucleic Acid, 335; 808
Barnard (S.), and J. M. Child, Advanced Algebra (*Review*), 665
Barnell (H. R.), Ripening of the Banana, 494
Barry (V. C.), and Prof. T. Dillon, Occurrence of Xylans in Marine Algæ, 620
Bassett (M. J.), Attainment of Very High Pressures, 103
Baughan (E. C.), Resonance in the Chloracetic Acids, 461; and Prof. M. Polanyi, Energy of Aliphatic Carbon Links, 685
Bawden (F. C.), appointed head of the Department of Plant Pathology at Rothamsted Experimental Station; work of, 331
Baxter and Titus; and Lundstedt, Atomic Weight of Iodine, 405
Bayliss (E. P.), Map of Antarctica, 22
Bayon (Dr. H. P.), The School of Salerno, 57
Beadle (L. C.), and J. B. Cragg, Osmotic Regulation in Freshwater Animals, 588
Beale (G. H.), Genetics of Verbena, 495; J. R. Price and R. Scott-Moncrieff, Biochemistry of Flower Pigments in Verbena, 690

Beard (J. R.), Electrical Engineers and the War, 615; Planning the Post-War World, 692
Beauchamp (R. S. A.), Chemistry and Hydrography of Lakes Tanganyika and Nyasa, 253
Bedford (Duke of), [death], 295; [obituary article], 394
Beeson (C. F. C.), and N. C. Chatterjee, Biological Control of *Lantana aculeata*, 809
Beevers (Dr. C. A.), and W. Hughes, Crystal Structure of Rochelle Salt, 96
Begon (Dr. L.), Murder by Children and Adolescents, 456
Beharrel (J.), Kitchen Waste for Feeding Farm Stock, 47
Bejarano (Dr. J.), Diet and Nutrition in Colombia, 338
Belcher (R.), and R. V. Wheeler, Composition of Coal, 525
Bell (A. E.), Christian Huygens, 1629–1695, 511
Bell (Dr. D. J.), Introduction to Carbohydrate Biochemistry (*Review*), 545
Bell (D. J.), and Dr. E. Baldwin, *l*-Galactose as a component of a Polysaccharide of Animal Origin, 559
Bell (Florence O.), [Dr. W. T. Astbury, C. S. Hanes and], X-Ray comparison of Natural and Synthetic Starch, 558
Bell (Prof. H. P.), Core Disease in the Apple, 34
Bell (R. P.), Resonance in the Chloracetic Acids, 166
Bellamy (D.), Heating Private Air Raid Shelters, 517
Bellerby (Prof. J. R.), awarded a Leverhulme research fellowship, 93
Bendall (F. W. D.), appointed adviser in educational matters to Service men and women, 396
Beneš (Dr.), Czech Culture under German Rule, 126
Bennett (C. V.), [death], 740
Bennett (Dr. H. H.), Soil Conservation (*Review*), 415
Benson (Prof. W. N.), [R. A. Keble and], Graptolites of Australia, 561
Bent (A. C.), More Life-histories of North American Birds, 689
Beresford (J. B.), [death], 553
Bergmann (Dr. E.), [Prof. C. Weizmann, Prof. V. Henri and], Identification and Determination of Aromatic Compounds in Mineral Oils, 230
Bernal (Prof. J. D.), M. V. Lomonosov (1711–1765), 16
Bersu (G.), Excavation at Little Woodbury, Wilts: The Settlement as Revealed by Excavation, 841
Bertram (C.), Arctic and Antarctic: the Technique of Polar Travel (*Review*), 282
Beust (Nora E.), 500 Books for Children, 23
Beveridge (Sir William), appointed commissioner for available resources of man-power, 23
Bhaduri (P. N.), and C. S. Semmens, Advantages of Uranium Fixation in Modern Cytological Technique, 100
Bhatia (Dr. B. L.), The Fauna of British India, including Ceylon and Burma: Protozoa: Sporozoa (*Review*), 384
Bhatia (D.), Peculiar Water Relations of a Diatom, 591
Biancolli (L.), Stereophonic Recordings of Enhanced Music, 174
Bierens de Haan (Dr. J. A.), Die tierischen Instinkte und ihr Umbau durch Erfahrung: eine Einführung in die allgemeine Tierpsychologie (*Review*), 317
Birkenhauer (H.-F.), The Illinois Basin Earthquake of November 23, 1939, 809
Birnbaum (N.), [S. M. Edmonds and], Solubility of Lead Salts, 720
Birnbaum (Dr. H.), Depopulation in France, 427
Bisby (G. R.), and E. W. Mason, Pyrenomycetes recorded for Britain, 748
Bitter (F.), Magnetic Properties of the Transition Elements, 405
Black (R.), [E. W. Sinnott and], Cell-division, 68
Blackett (Prof. P. M. S.), awarded a Royal medal of the Royal Society, 679; work of, 750
Blackie (A.), Visible Sound Waves, 369
Blackman (Prof. A. M.), Recent British Excavations in Egypt (*Review*), 664
Blackwall (Elizabeth), Life-cycle of *Blastocladia Pringsheimii*, 495
Blagden (Dr. J. W.), [death], 833
Blair (Prof. D. M.), Problems of Neurohistology (*Review*), 571
Blake (G. S.), [death], 55
Blakeslee (Dr. A. F.), Induced Evolution through Chromosome Changes, 269
Blüh (Dr. O.), Mixed Radioactive Indicators in Physiological Experiments, 233
Bodio (L.), centenary of the birth of; work of, 488
Boeke (Prof. J.), Problems of Nervous Anatomy (*Review*), 571
Bonn (M. J.), Totalitarian States and the place of Economics in World Affairs, 241
Booth (H. S.), and M. C. Cassidy, Thiophosphoryl Chlorofluorides, 749
Born (Prof. Max), Sir J. J. Thomson, 356
Borsinger (P.), Swiss Short-Wave Emissions, 58
Bosazza (Dr. V. L.), Adsorption of Malachite Green by Clays and Allied Minerals, 334; Occurrence of Vanadium and Molybdenum in Clays, 746
Boswell (Prof. P. G. H.), Geological History and Mineral Resources of South Africa (*Review*), 214
Boswell and Whiting, Respiration in the Higher Plant, 783
Bound (M.), [Dr. G. D. Rochester and], Absorption of Cosmic Ray Protons in Lead, 745
Bounoure (Prof. L.), L'Origine des cellules reproductrices et le problème de la lignée germinale (*Review*), 822
Bourne (Sir Alfred), [death], 88
Bourne (Dr. G.), Nutrition and the War (*Review*), 571
Bourneville (Dr. D. M.), centenary of the birth of; work of, 488
Bowen (Prof. N. L.), Nodal Points on Crystallization Curves of Solid Solutions, 562; Physical Controls in Adjustments of the Earth's Crust, 563
Bower (Sir Percival), Rising Cost of Generating Electricity, 92
Bowie (Dr. W.), [death], 516; [obituary article], 645
Boyd (E.), [Prof. W. D. Harkins, Dr. T. F. Young and], Energy and Entropy of Extension and Spreading of Mobile Monolayers, 406
Boyd (G.), Electric Utilities at the New York World's Fair, 487
Boyes (J. W.), [H. Peto and], Triploid Sugar Beet, 748
Boyle (Dr. R. W.), presented with the Flavelle medal of the Royal Society of Canada, 171
Boys (Sir Charles), Sir Oliver Lodge, 327
Bradford (Dr. S. C.), Information and Progress in Engineering and Industry (*Review*), 7
Bragg (Sir William), Sir J. J. Thomson, 352; The Extra Spots of the Laue Photograph, 509; Science and National Welfare, 731, 741
Bragg (Prof. W. L.), The Physics of Metals (Norman Lockyer lecture), 275; Sir J. J. Thomson, 354
Brandes (Prof. G.), Buschi: Vom Orang-Säugling zum Backenwülster (*Review*), 150
Brasher (W. K.), and B. P. Moss, Supersonic Signal Method for Telephone Calls, 300
Breit (G.), Theory of Nuclear Resonances, 592
Breit (Juanita), [Prof. J. C. Fardon, Rev. G. Brotzge, Sister M. Kenneth Loeffler and], Attraction Fields *in vitro*, 619
Brenchley (Dr. Winifred E.), Woodlands in Agriculture (*Review*), 475
Bretscher (Dr. E.), Radioactivity of Be^{10}, 94; and L. G. Cook, Production of Actinium C'' from Lead, 430
Brewer (Dr. A. K.), [Dr. A. Lasnitzki and], Increase of Heavy Potassium in Plasma, 807
Brewer (Griffith), elected president of the Royal Aeronautical Society; work of, 19
Briggs (Prof. E. A.), Anatomy of the Sheep's Brain: a Laboratory Atlas for Students of Zoology (*Review*), 546
Briggs (R. W.), Tumour Induction in *Rana pipiens* Tadpoles, 29
Brightman (R.), Scientific Organization of Work (*Review*), 284; Preparation of Reports (*Review*), 419
Brink (R. A.), [E. G. Anderson and], Cytogenetics of Maize, 270
Brinton (C.), Social Progress, 742
Britton (E. B.), Insect Fauna of a Hornbill's Nest, 33
Brøgger (A. W.), Development of Norwegian Cultural History, 67

Bromehead (C. E. N.), Cornish Tin Mining, 405
Broom (Dr. R.), Classification of Sub-human Types, 94
Brotzge (Rev. G.), [Prof. J. C. Fardon, Sister M. Kenneth Loeffler, Juanita Breit and], Attraction Fields *in vitro*, 619
Brown (F. G. W.), The Theory of Group Representations (*Review*), 283
Brown (Prof. W.), Plant Disease in relation to the Public (Chadwick lecture), 118
Browne (A. W.), [J. A. Wheat and], Perchlorides of Hydrogen, 434
Brownlea (A.), Drinking Habits of Animals, 522
Broyer (T. C.), [Prof. D. R. Hoagland, P. R. Stout and], Upward Movement of Salt in the Plant, 340
Brückmann (Dr. G.), and Prof. S. G. Zondek, 'Congenital' Copper Deposit in the Rat, 30
Brunauer (S.), and others, Van der Waals Adsorption of Gases, 371
Brunt (Prof. D.), Weather and Weather Prophets (*Review*), 818
Bryant (A.), Unfinished Victory (*Review*), 209
Bryson (V.), [L. C. Dunn, S. Gluechsohn-Schoenheimer and], Genetics of the Tails of Mice, 689
Bucher (Prof. W. H.), Origin of the Submarine Valleys on the Continental Slopes of the North Atlantic, 407
Buckingham (Dr. R. A.), [Prof. H. S. W. Massey and], Collisions of Neutrons with Deuterons and the nature of Nuclear Forces, 776
Buckley (Dr. O. E.), appointed president of the Bell Telephone Laboratories, Inc., 834
Bull (Prof. H. S.), Direct-Current Machinery (*Review*), 668
Bullard (Dr. E. C.), Submarine Geology and Geophysics, 432
Bullen (Dr. K. E.), appointed to the Department of Mathematics in Melbourne University, 458
Burdon (Prof. K. L.), A Textbook of Microbiology. Second edition of "A Textbook of Bacteriology" (*Review*), 149
Burg (A. B.), Methylboric Acid, 690
Burkill (I. H.), [Sir David Prain and], An Account of the genus Dioscorea in the East. Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary (*Review*), 503
Burkitt (M. C.), Stone Age Cilicia, 58
Burlinghame (Dr. C. C.), Psychology in War-time, 712
Burnet (W. C.), [death], 224
Burnham (C. R.), and J. L. Cartledge, Smut Resistance and Interchanges in Maize, 622
Burtt-Davy (Dr. J.), [death], 295; [obituary article], 424
Butler (E. T.), and Prof. M. Polanyi, Influence of Substitution on Organic Bond Strength, 129
Butler (Dr. J. A. V.), Electrocapillarity: the Chemistry and Physics of Electrodes and other Charged Surfaces (*Review*), 536
Buxton (M. B.), [death], 584
Byerly (P.), Seismicity of the Northern Pacific Coast of U.S.A., 270

Caclamanos (Demetrius), Science in its Infancy (*Review*), 76
Cadwallader (C. J.), F. O. Howitt and S. G. Smith, Reversibility of the Denaturation of Silk Fibroin, 301
Cady (G. H.), [C. H. Secoy and], Chlorine Monoxide and Water, 136
Caldin (E. F.), The Functions of Science, 403
Caleb (Prof. C. C.), [death], 328
Callendar (Dr. L. H.), Formation of Protective Films, 304
Calvert (B.), Transformer Insulating Oils, 594
Calvert (E. L.), [A. E. Muskett and], Blind Seed Disease of Rye-Grass, 200
Calvin (M.), M. Kodani and R. Goldschmidt, Salivary Gland Chromosomes, 269
Cammerer (A. B.), National Parks in Conservation, 205
Campbell (K. W. D.), Dual-purpose Cows (*Review*), 285; Farm Management: In-going and Out-going, Insurance, Income Tax, Credit and Farm Records (*Review*), 601
Campbell (N.), Qualitative Organic Chemistry (*Review*), 822
Canterbury (Archbishop of), and others, Racial Freedom and the Colour Bar, 396
Carey (W. F.), Growth of Aggregates in Suspensions, 232
Carlier (Prof. E. W. W.), [death], 360; [obituary article], 452
Carmichael (W.), Treatment of Household Refuse, 83
Carpenter (Prof. G. D. Hale), Dr. R. Hanitsch, 360
Carpenter (Sir Harold), Henry Bessemer and Sidney Gilchrist Thomas (*Review*), 245; [death], 395; [obituary article], 483
Carr (Prof. E. H.), The Twenty Years' Crisis, 1919–1939: an Introduction to the Study of International Relations (*Review*), 209
Cartledge (J. L.), [C. R. Burnham and], Smut Resistance and Interchanges in Maize, 622
Cartwright (C. H.), J. Daniel and A. Petrauskas, Infra-Red Transmission of the Human Body, 591
Case (A. H.), [obituary article], 257
Cassidy (M. C.), [H. S. Booth and], Thiophosphoryl Chlorofluorides, 749
Cave (A. J. E.), Early Iron Age Burial, Bedfordshire, 370
Cawston (Dr. F. Gordon), Blunted Teeth of Lymnœidæ, 654
Cerecedo (Dr. L. R.), Physiology of Pyrimidines, 274
Chadwick (Prof. J.), Excited States of Stable Nuclei, 401
Chain (Dr. E.), [Dr. E. P. Abraham and], An Enzyme from Bacteria able to Destroy Penicillin, 837
Challis (H. J. G.), [Dr. J. Newton Friend, R. H. Vallance and], Phosphate Separation in Qualitative Analysis, 63
Chalmers (Dr. Bruce), Non-parallelism of Lattice Planes in Tin Coatings on Steel, 493
Chamberlain (Neville), death of; activities of, 646
Chambers (late Sir William), Life and Work of, 363
Champion (Dr. F. C.), [Dr. C. F. Powell, H. Heitler and], Neutron-Proton Scattering at High Energies, 716
Chance (M. R. A.), [J. Madinaveitia, Prof. A. R. Todd, A. L. Bacharach and], Mucolytic Activity of Diffusing Factor Preparations, 197
Chandler jun. (R. F.), Cation Exchange Properties of certain Forest Soils in the Adirondack Section, 434
Chapman (F.), Types of Californian Miocene Foraminifera, 63; A New Genus of Fossil Sponges, 809
Chapman (P.), Guidance Programs for Rural High Schools, 743
Chapman (Prof. S.), Dependence of Thermal Diffusion on the Concentration Ratio, 431; Molecular Fields of Force: Retrospect and Suggestions, 607; Molecular Fields of Force, 747
Chasen (F. N.), Hand-list of Malaysian Mammals, 689
Chatt (J.), and F. G. Mann, Phosphonium, Arsonium and Stibonium Salts, 525
Chatterjee (N. C.), [C. F. C. Beeson and], Biological Control of *Lantana aculeata*, 809
Chaudhuri (P. C.), Photographic Proper Motions in the Præsepe Cluster, 307
Chauvisé (Dr. J. M.), Infectious Diseases and Aeroplanes, 363
Cheal (W. F.), Strawberry Yellow-edge Virus, 68
Cheesman (G. H.), D. R. Duncan and I. W. H. Harris, Sodium Polyiodides, 562
Chen (Tze-Tuan), Polyploidy in Paramecium, 68
Chessum (Alfred Stanley), [obituary article], 18
Child (E.), The Tools of the Chemist: Their Ancestry and American Evolution (*Review*), 604
Child (J. M.), [S. Barnard and], Advanced Algebra (*Review*), 665
Chiplonkar (M. W.), Distribution of Temperature in the Lower Stratosphere, 170
Chopra (Brevet-Col. R. N. and Capt. G. S.), Hemp Drug Addiction in India, 487
Chorghade (S. L.), [Prof. K. S. Krishnan, T. S. Ananthapadmanabhan and], Dimorphism of Diphenyl Octatetraene Crystals, 333
Christophersen (E.), and others, translated by R. L. Benham, Tristan da Cunha: the Lonely Isle (*Review*), 821
Clapham (A. W.), Archæology During and After the War, 426

Clark (Prof. A. J.), appointed to the advisory board of the trustees of the Beit Memorial Fellowships for Medical Research, 163
Clark (H. Lyman), Ophiuroidea of the Murray Expedition, 33
Clark (Dr. J. G. D.), New World Origins, 21
Clark (Dr. R. E. D.), Production of Randomness as a Suggested Measure of Intelligence, 369
Clark (Prof. W. E. Le Gros), Anatomical Basis of Colour Vision, 558
Clarke (Dr. J. S.), awarded the Crompton medal of the Institution of Automobile Engineers, 557
Clemens (Dr. W. A.), appointed head of the zoology department of British Columbia University, 490
Cloetta (Prof. Max), [death], 453
Clow (Dr. A.), Deliquescence in Urea and Methyl-ureas, 26
Clynes (J. R.), When I Remember (*Review*), 409
Cochrane (Dr. R. G.), Dr. M. Paulraj and Miss M. D. Salmond, Wheat Diet and Leprosy, 497
Codling (J. H.), Treatment of Abattoir Wastes, 9
Cohen (Dr. J. I.), Mental Tests (*Review*), 46
Cohen (Dr. K.), [Dr. D. W. Stewart and], Isolation of a Heavy Sulphur, 555
Colebrook (F. M.), Field Produced by a Linear Radiator, 35
Colhoun (J.), [A. E. Muskett and], Prevention of Seedling Blight in the Flax Crop, 32
Collier (Dr. H. O. J.), Depression of Neuro-Muscular Transmission in a Crab by Phenothiazine, 232
Collinge (Dr. W. E.), Relation of Museums to Commerce, 526; impending retirement of; work of, 554
Collip (J. B.), H. Selye and D. L. Thomson, Antihormones, 463
Common (Dr. R. H.), Plasma Alkali Reserve in the Domestic Fowl, 98
Compton (Prof. A. H.), awarded the Hughes medal of the Royal Society, 679; work of, 752
Conway (Prof. E. J.), Micro-Diffusion Analysis and Volumetric Error (*Review*), 113
Cook (Prof. E. S.) and C. W. Kreke, Ability of Respiratory-stimulating Factors to Overcome Toxic Action of Germicides on Moulds, 688
Cook (Prof. J. W.), Some Biological Applications of Synthetic Chemistry, 752
Cook (L. G.), [Dr. E. Bretscher and], Production of Actinium C″ from Lead, 430
Cooke (W. B.), Genera of the Pore Fungi, 405
Cooper (Dr. E. R. A.), Human Histology: a Guide for Medical Students (*Review*), 385
Cope (E. T.), and W. F. Kinney, Heat Insulation in Electric Power Stations, 844
Cope (F. W.), A Lower Carboniferous Brachiopod, 690
Coppen (F. M. V.), [Dr. G. W. Scott-Blair and], Compression of Cylinders of Soft Materials, 840
Corder (P.), and C. F. C. Hawkes, Celtic Ornament from Elmswell, Yorks, 433
Corner (H. H.), and Dr. A. M. Smith, Cobalt and Pine Disease, 168
Cort (Henry), Bicentenary of the birth of; work of, 722
Cott (Dr. H. B.), Adaptive Coloration in Animals (*Review*), 144
Coulson (A. L.), Meteorites in the Indian Museum, 299
Coxeter (Prof. H. S. M.), The Generalized Kaleidoscope, 232
Cragg (J. B.), [L. C. Beadle and], Osmotic Regulation in Freshwater Animals, 588
Cramer (R.), [G. B. Kistiakowsky and], Synthesis of Radioactive Lactic Acid, 562
Cramer (Dr. W.), appointed to the staff of the Barnard Free Skin and Cancer Hospital in St. Louis, 300
Crane (M. B.), Origin of the Loganberry, 202; Reproduction in Rubus, 337
Crang (Alice), and Margery Mason, "Growmore" Bulletin, No. 3, 260
Crawford (W.), [A. B. Edwards and], Tertiary Volcanic Rocks of Victoria, 622
Crocker (J. C.), appointed head of the chemistry department of Chelsea Polytechnic, 93
Crookall (Dr. R.), Studies in Fossil Botany (*Review*), 249
Cross (L. C.), C. G. Eliot, I. M. Heilbron and E. R. H. Jones, Constituents of the Higher Fungi, 102
Crosthwait (Col. H. L.), [obituary article], 553
Crowther (Prof. J. A.), Sir J. J. Thomson, 351; The Conquest of Energy (*Review*), 760
Crowther (J. G.), Wells's Babes in the Darkling Wood (*Review*), 822
Cullen (Dr. W.), Mineral Products of the British Empire and U.S.A., 772
Cummins (G. B.), Rust Fungi of the genus Prospodium, 102
Cushman (F.), Training Procedure (*Review*), 421; and H. A. Friede, The Fire Alarm System in the United States, 408

Dabholkar (V. D.), [Prof. H. J. Taylor, D. Fraser and], The Possibility of Detecting a Doubly-charged Proton by the Photographic Method, 777
Dale (Sir Henry), elected president of the Royal Society; work of, 741; now a member of the War Cabinet Scientific Advisory Committee, 805
Dalrymple-Hay (Sir Harley H.), [death], 833
Dampier (Sir William), Sir J. J. Thomson, 352
Daniel (J.), [C. H. Cartwright, A. Petrauskas and], Infra-red Transmission of the Human Body, 591
Danielli (Dr. J. F.), [D. A. Webb and], Concentration of Cations at Negatively Charges Surfaces, 197
Dankert (L. J.), [R. Adams and], Restricted Rotation in Arylamines, 690
Darling (Dr. F. Fraser), Island Years (*Review*), 474
Darlington (Dr. C. D.), Meiosis, 433; Mind and Matter, 808
Dasgupta (Dr. S.), A History of Indian Philosophy. Vol. 3 (*Review*), 446
Davenport (Dr. H.), Theory of Numbers (*Review*), 418
Davies (Col. C. E.), re-elected president of the Newcomen Society, 682
Davies (G. M.), [Dr. J. W. Evans and], Elementary Crystallography. Second edition (*Review*), 544
Davies (Dr. R. M.), awarded a Leverhulme research fellowship, 93
Davis (F. M.), [obituary article], 55
Debye (Prof. P.), appointed professor, and chairman of the chemistry department at Cornell University, 163
Dehlinger (Prof. U.), Chemische Physik der Metalle und Legierungen (*Review*), 447
Demerec (M.), and E. Sutton, Unequal Breaks in Sister Chromatids, 592
Denny-Brown (Major D.), Sir Henry Head, 583
Deoras (P. J.), Structure of *Heminerus deceptus* Rehn, var. *ovatus*, and the classification of Dermoptera, 201
Deraniyagala (P. E. P.), appointed acting director of the Colombo Museum, 557
Desai (B. N.), and S. Mal, Thunderstorms at Karachi, 136
Desch (Dr. C. H.), Sir Harold Carpenter, 483; Sir Robert Hadfield, Bart., 644
Desnuelle and others, Anaerobic Degradation of Cystine and Cysteine, 189
Dewey (Prof. J.), Freedom and Culture (*Review*), 815
Dickie (W. M.), Sir James Baillie, 54
Dickinson (Dr. H. W.), The Life and Activities of Henry Cort, 722
Dickson (Prof. L. E.), New First Course in the Theory of Equations (*Review*), 250; Modern Elementary Theory of Numbers (*Review*), 418
Dillon (Prof. T.), [V. C. Barry and], Occurrence of Xylans in Marine Algæ, 620
Dingle (Prof. H.), Prof. Alfred Fowler, 86; The Rate of a Moving Clock, 391
Dobzhansky (Prof. T.), appointed professor of zoology in Columbia University, New York, 775
Dirac (Prof. P. A. M.), Dr. M. Mathisson, 613
Docking (A. R.), Dr. E. Heymann, Lucy F. Kerley and K. N. Mortensen, Evaporation of Water through Multimolecular Films, 265
Doisy (Prof. E. A.), Ovarian Follicular Hormones, 624
Doljanski (Prof. L.), and M. Pikovski, Cultivation of the agent of Fowl Leukosis *in vitro*, 302
Dollman (Capt. Guy), Major P. H. G. Powell-Cotton, 224

Donald (C. M.), [D. S. Riceman, S. T. Evans and], Copper-deficient Australian Soils, 434
Donald (Dr. H. P.), The Science of Animal Breeding (*Review*), 667
Donnan (Prof. F. G.), Prof. N. T. M. Wilsmore, 360
Doob (Prof. L. W.), The Plans of Men (*Review*), 383
Dorsey (Dr. N. E.), Properties of Ordinary Water-Substance in all its Phases: Water-vapour, Water and all the Ices (*Review*), 145
Dowle (R. V.), [E. C. Toghill and], Applications of Cast Iron in Modern Automobile Construction, 208
Drechsler (C.), Fungus Parasites of Nematodes, 336
Druce (F.), resignation of the honorary treasurership of the Linnean Society, 650
Drummond (Prof. J. C.), [Dr. T. Moran and], Reinforced White Flour, 117; and others, The Nation's Larder and the Housewife's Part Therein: a set of Lectures delivered at the Royal Institution of Great Britain in April, May and June, 1940 (*Review*), 727
Dublin (Dr. L. J.), Problems Arising from an Ageing Population, 566
Du Bois (Cora), Amerindian Religious Reactions to Cultural Impact, 169
Dubreuil (H.), A Chance for Everybody: a Liberal Basis for the Organization of Work (*Review*), 284
Dugan (Prof. R. S.), [death], 516
Dunbar (C.), presented with the Leon Gaster memorial premium of the Illuminating Engineering Society, 555
Duncan (D. R.), [G. H. Cheesman, I. W. H. Harris and], Sodium Polyiodides, 562
Duncan-Jones (Very Rev. Dr. A. S.), The Crooked Cross (*Review*), 409
Dunn (L. C.), S. Gluechsohn-Schoenheimer and V. Bryson, Genetics of the Tails of Mice, 689
Dunstan (Dr. A. E.), The Utilization of Petroleum Gases, 185
Durham (H. H.), and A. M. Banta, Colchicine Treatment of Daphnia, 170
Dusser de Barenne (Prof. J. G.), [death], 123

Ecale (Dr. E.), History of Blood Transfusion, 228
Eckles (Dr. C. H.), Dairy Cattle and Milk Production. Third edition, revised by E. L. Anthony and Prof. L. S. Palmer (*Review*), 285
Edgell (J. F. E.), Scale Formation in Electric Water-Heaters, 592
Edmonds (S. M.), and N. Birnbaum, Solubility of Lead Salts, 720
Edwards (A. B.), and W. Crawford, Tertiary Volcanic Rocks of Victoria, 622
Edwards (Dr. F. W.), [death], 678; [obituary article], 739; H. Oldroyd and Dr. J. Smart, British Blood-Sucking Flies (*Review*), 447
Edwards (Dr. G.), Philip Syng Physick, work of, 20
Egloff (G.), Physical Constants of Hydrocarbons. Vol. 2 (*Review*), 507
Einstein (Prof. A.), admitted to American citizenship, 490; Science and Religion, 605
Eirich (Dr. F. R.), and Prof. E. K. Rideal, The Air-driven Ultracentrifuge, 541
Eldridge (A. A.), Annual Reports on Chemistry (*Review*), 416
Eley (D. D.), and Prof. E. K. Rideal, Parahydrogen Conversion on Tungsten, 401
Eliot (C. G.), [L. C. Cross, I. M. Heilbron, E. R. H. Jones and], Constituents of the Higher Fungi, 102
Ellerton (S.), [A. E. Watkins and], Genetics of Awns in Triticum, 135
Ellis (Dr. W.), The Idea of the Soul in Western Philosophy and Science (*Review*), 531
El-Nasr Eff (Abd El-Ghani Seif), [G. Howard Jones and], Control of Smut Diseases in Egypt with special reference to Sowing Depth and Soil Moisture, 135
Elvehjem (Prof. C. A.), The Vitamin B complex in Normal Nutrition, 669
Emden (Prof. R.), [death], 833
Emory (K. P.), Archæology of Fanning Island, 494
v. Engel (Dr. A.), Current Distribution and Throwing Power in Electrolytes, 66
Erb (Prof. Wilhelm Heinrich), centenary of the birth of; work of, 715
Evans (Dr. A. H.), A Flora of Cambridgeshire; with an Appendix on the Origin and Drainage of the Fens (*Review*), 250
Evans (Prof. C. Lovatt), Dr. Phyllis M. Tookey Kerridge, 159
Evans (D. G.), Production of *pertussis* Antitoxin, 748
Evans (E. E.), [W. Machle and], Exposure to Fluorine in Industry, 330
Evans (Dr. J. W.), and G. M. Davies, Elementary Crystallography. Second edition (*Review*), 544
Evans (R. D.), Toxicity of Alpha and Fast Neutron Radiation, 621
Evans (S. T.), [D. S. Riceman, C. M. Donald and], Copper-deficient Australian Soils, 434
Evans-Pritchard (Dr. E. E.), The Political System of the Anuak of the Anglo-Egyptian Sudan (*Review*), 279; The Nuer: a Description of the Modes of Livelihood and Political Institutions of a Nilotic People (*Review*), 568
Eysenck (Dr. H. J.), Psychology and Camouflage, 620
Ezoe (H.), [Dr. Y. Nishina, T. Yasaki, Prof. K. Kimura, M. Ikawa and], Fision products of Uranium produced by Fast Neutrons, 24

Fabergé (A. C.), X-Ray Radiation on Tradescantia Chromosomes, 524
Fakhoury (Dr. N.), and Dr. M. Wahba, Swelling of Wood Charcoal: Experiments with a New Silica Extensometer, 63
Fardon (Prof. J. C.), Rev. G. Brotzge, Sister M. Kenneth Loeffler and Juanita Breit, Attraction Fields *in vitro*, 619
Farr (W. K.), Structure and Composition of Plant Cell Membranes, 153
Fassett (Prof. N. C.), A Manual of Aquatic Plants (*Review*), 700
Fawssett (E.), H. W. Grimmitt, G. F. Shotter and Dr. H. G. Taylor, Practical Aspects of Earthing, 623
Federn (Dr. K.), The Materialist Conception of History (*Review*), 600
Feldberg (W.), Prof. D. Keilin and Dr. T. Mann, Activity of Carbonic Anhydrase in relation to Gastric Secretion, 651
Fell (H. B.), Culture *in vitro* of the Excised Embryo of an Ophiuroid, 173; F. Hutchinson, 484
Fenger (Dr. Christian), centenary of the birth of; work of, 586
Ferguson (H. H.), and W. R. Geddes, Visibility and Road Accidents, 694
Fermi (Prof. E.), Reactions produced by Neutrons in Heavy Elements, 640
Fiedler (K.), Monograph of the South American Weevils of the genus Conotrachelus (*Review*), 150
Fielden (G. St. Clair), and R. J. Garner, Vegetative Propagation in Tropical Plantations, 91
Fildes (Dr. P.), appointed honorary secretary to the trustees of the Beit Memorial Fellowships for Medical Research, 163
Fink (H. K.), Hereditary Nose-bleeding, 561
Finlayson (Dr. James), centenary of the birth of; work of, 648
Finn (S. R.), [A. H. Baker and], Hydration of Carbon Dioxide and its Influence on Germicidal Activity of Hypochlorite Aerosols, 747
Firth (R.), Size of Family in Tikopia, 404
Fischer (C. E. C.), Asiatic Yams (*Review*), 503
Fisher (J.), [E. M. Nicholson and], Birds on St. Kilda, 235
Fisher (Prof. R. A.), and Dr. K. Mather, Non-Lethality of the mid factor in *Lythrum Salicaria*, 521
Fisher (Dr. R. C.), Beetles Injurious to Timber and Furniture, 773
Fitzmaurice (R.), and W. Allen, Sound Transmission in Buildings: Practical Notes for Architects and Builders (*Review*), 417

Fitzpatrick (H. D. N.), [K. W. Yarnold and], Radiation and 'Stuffiness', 62
Fleming (Sir Ambrose), Sir Oliver Lodge, 327
Fleming (Prof. A.), Antiseptics in War-time Surgery, 680
Fleming (Dr. J. A.), Geomagnetic Research in the Americas, 273
Fleming (J. H.), [death], 190
Fleming (Rev. W. L. S.), Piedmont Glaciers, 371
Fletcher (G. L.), Earth Science: a Physiography (*Review*), 80
Fleure (Prof. H. J.), The Celtic West, 649
Flynn (Prof. T. T.), and Prof. J. P. Hill, Development of the Monotremata, Part IV, 339
Fogg (W.), Shrine and Market in Morocco, 169
Forde (Prof. Daryll), Fruits of the Renaissance in Archæology (*Review*), 213
Fordham (S.), Electron Diffraction Intensities, 807
Forsling (C. L.), Conservation of Forest Resources, 204
Forster (E. M.), Nordic Twilight (*Review*), 409
Fort (Margaret), Extreme Specialization of a Rust Fungus, 337
Fowler (Dr.), Intelligence Among Australian Aborigines, 195
Fowler (Prof. Alfred), [obituary article], 86
Fowler (Prof. G. H.), [death], 257
Frankel (J. J.), Etching Reagent for Chromite, 198
Frankel (O. H.), Male Sterility in Hebe, 34; and others, Studies of Meiosis, 656
Franklin (T. B.), [J. C. Maby and], The Physics of the Divining Rod (*Review*), 150
Franks (R.), [A. B. Kinzel and], The Alloys of Iron and Chromium. Vol. 2: High-Chromium Alloys (*Review*), 506
Fraser (D.), [Prof. H. J. Taylor, V. D. Dabholkar and], The Possibility of Detecting a Doubly-charged Proton by the Photographic Method, 777
Fraser (H. G.), Oxford Electric Supply Undertaking, 556
Frazer (Sir James), Prof. C. G. Seligman, 515
Frazer (Prof. J. E.), A Manual of Embryology: the Development of the Human Body. Second edition (*Review*), 728
Frecheville (Prof. W.), [death], 190; [obituary article], 223
Freke (C. W.), [Prof. E. S. Cook and], Ability of Respiratory-stimulating Factors to Overcome Toxic Action of Germicides on Moulds, 688
de Fremery (P.), [Dr. J. F. Wilkinson and], Gonadotropic Hormones in the Urine of the Giraffe, 491
French (Dr. J. Weir), Prof. L. O. M. von Rohr, 515; Cryolite Films on Glass Surfaces, 687
Friede (H. A.), [F. Cushman and], The Fire Alarm System in the United States, 408
Friend (Dr. J. Newton), R. H. Vallance and H. J. G. Challis, Phosphate Separation in Qualitative Analysis, 63
Frosch (C. J.), [C. S. Fuller, N. R. Pape and], Polyisobutylene, 656
Fuller (C. S.), C. J. Frosch and N. R. Pape, Polyisobutylene, 656

Gafafer (W. M.); and Rosedith Sitgreaves, Cancer in an Oil Refinery, 617
Gamble (L.), and P. Gilmont, Diborane Diphosphine, 69
Gamow (Prof. G.), The Evolution of the Stars, 97
Gardiner (Prof. J. Stanley), Madreporarian Corals of the "Discovery" Expedition, 67; and Peggy Waugh, Corals of the John Murray Expedition, 169
Gardner (Prof. A. D.), Morphological Effects of Penicillin on Bacteria, 837
Garner (R. J.), [G. St. Clair Fielden and], Vegetative Propagation in Tropical Plantations, 91
Garnett (Dr. Maxwell), A Lasting Peace; with some chapters on the basis of German co-operation (*Review*), 209
Garstang (Prof. J.), and J. B. E. Garstang, The Story of Jericho (*Review*), 601
Garstang (J. B. E.), [Prof. J. Garstang and], The Story of Jericho (*Review*), 601
Gatty (Oliver), [obituary article], 17
Gaydon (Dr. A. G.), awarded a Leverhulme research fellowship, 93
Geddes (W. R.), [H. H. Ferguson and], Visibility and Road Accidents, 694
Gentcheff (G.), and A. Gustafsson, Combined Fertilization and Apomixis, 434
Gerhard (Dr. B.), appointed director of the Cleveland Museum of Health and Hygiene, 399
Gerlier (Dr. Félix), centenary of the birth of; work of, 295
Getman (F. H.), Trimethylcarbonol as a Cryoscopic Solvent, 720
Giacomini (Prof. C.), centenary of the birth of; work of, 682
Gibby (C. W.), and C. Argument, Adsorption at a Liquid Interface, 203
Gibert (A.), Cosmic Rays and Poisson's Law, 198
Gibson (Dr. A.), The Canadian Entomological Service, 90
Gibson (G. W.), and P. H. Gregory, Foliage Blight of the Bulbous Iris, 780
Gillespie (J. M.), [Dr. S. D. Rubbo and], Para-Amino Benzoic Acid as a Bacterial Growth Factor, 838
Gillespie (Dr. R. P.), Integration (*Review*), 665
Gillman (Dr. J.), Fat: an Index of Œstrogen and Progestogen Activity in the Human Endometrium, 402
Gilmont (P.), [L. Gamble and], Diborane Diphosphine, 69
Giri (K. V.), and P. V. Krishnamurthy, Co-existence of Oxidizing and Protective Mechanisms for Vitamin C in Plant Tissues, 99
Glaister (Prof. J.), Science and Crime (*Review*), 414
Glass (D. V.), Population: Policies and Movements in Europe (*Review*), 381
Glasscock (H. H.), Blind Seed Disease of Rye-Grass, 368
Glasstone (Dr. S.), Fundamentals of Electrochemistry (*Review*), 534
Glees (Dr. P.), Termination of Optic Fibres in the Lateral Geniculate Body, 747
Glennie (E. A.), Night-Shining Eyes, 366
Glover (Dr. E.), The Psychology of Fear and Courage, 361
Gluechsohn-Schoenheimer (S.), [L. C. Dunn, V. Bryson and], Genetics of the Tails of Mice, 689
Goldhaber (M.), Mechanism of the Neutron Loss Reaction produced by Deuterons, 167
Goldschmidt (Prof. J.), [death], 453
Goldschmidt (R.), [M. Calvin, M. Kodani and], Salivary Gland Chromosomes, 269
Good (P.), British Standards Institution, 406
Goodey (Dr. T.), Catalogue of Nematode Parasites of Plants, 229
Goodfellow (D. M.), Tyneside: the Social Facts, 485
Gooding (E. J.), Standard Disks in the Strain Testing of Glass, 780
Goodnight (C. J.), Branchiobdellidæ from North America, 371
Gordon (Seton), Tristan da Cunha and its Birds (*Review*), 821
Gould (Surgeon Rear-Admiral E. L. Pearce), [death], 190
Gourlay (W. B.), "Elephants and Ethnologists", 21
Gover (J. E. B.), A. Mawer and F. M. Stenton, The Place-Names of Nottinghamshire (*Review*), 820
Grainger (Dr. J.), Virus and Vital Organization, 539
Grainger (Dr. J.), Problems of the Virus (*Review*), 602
Gralén (N.), [Dr. A. G. McCalla and], Gluten Protein, 60
Grant (Dr. Julius), The Cellulose Problem in War-time, 219; [J. A. Radley and], Fluorescence Analysis in Ultra-Violet Light. Third edition (*Review*), 216
Graton (L. C.), Nature of Ore-forming Fluids, 68
Gray (B.), Early Chinese Lacquer Toilet Boxes, 719
Gray (E. G.), [Dr. M. Wilson, M. Noble and], Blind Seed Disease of Rye-Grass, 492
Gray (Prof. J. A.), Studies in Beta and Gamma Rays, 171
Green (D. E.), Vegetable Pathology (*Review*), 758
Green (J. W.), Aspects of the Calculus of Variations (*Review*), 250
Greenhill (W. L.), Shrinkage of Australian Timbers, 557
Greenwood (Dr. T.), Indian Philosophy (*Review*), 446
Gregor (Dr. J. W.), Towards the New Systematics (*Review*), 42
Gregory (P. H.), [G. W. Gibson and], Foliage Blight of the Bulbous Iris, 780

Griffith (A. L.), Weeding Methods in Teak Plantations, 91
Griffiths (H. J.), Reactions of Miracidia of Sheep Liver-fluke, 464
Griffiths (M.), and Dr. F. G. Young, Does the Hypophysis secrete a Pancreotropic Hormone ? 266
Grimes (W. F.), [Dr., F. J. North and], The Legend of Llys Helig—its Origin and Significance, 455
Grimmitt (H. W.), [E. Fawssett, G. F. Shotter, Dr. H. G. Taylor and], Practical Aspects of Earthing, 623
Grossman (A. J.), [C. P. Smyth, G. L. Lewis, F. B. Jennings and], Dipole Moments and Structures, 136
Grossowicz (N.), [Prof. I. J. Kligler and], Function of Nicotinic Acid in the Metabolism of the Colon-Typhoid group of Bacteria, 652
Grundy (R. F. B.), The Essentials of Reinforced Concrete Design : a Simplified Text-book with special reference to both Old and New L.C.C. Regulations, and to the Code of Practice of the Building Research Board (*Review*), 347
Gudger (Dr. E. W.), Swordfish Attacking Vessels, 261
Guest (E.), Notation for Tapping Systems of the Rubber Tree, 193
Guise (C. H.), The Management of Farm Woodlands (*Review*), 475
Gumpert (Dr. M.), translated by M. Samuel, Heil Hunger ! Health under Hitler (*Review*), 529
Gunther (E. R.), [obituary article], 123
Gupta (Dr. R. L. Sen), Specific Ionization of Cosmic Ray Particles, 65
Gurney (R.), and M. V. Lebour, Crustacean Larvæ, 404
Gustafsson (A.), [G. Gentcheff and], Combined Fertilization and Apomixis, 434
Gutenberg (B.), and C. F. Richter, Earthquakes of South and Central America, 270
Guthrie-Smith (H.), [obituary article], 158
Guyot (M.), removed from the secretaryship of Paris University, 715
Guzmán (A. A.), Malaria in Costa Rica, 330

Haas (K. B.), Retail-Store Training, 428
Haberling (Prof. W.), [death], 740
Hadfield, Bart. (Sir Robert), [death], 453 ; [obituary article], 644
Hadham [J.], God in a World at War (*Review*), 501
Haeussler (G. J.), [H. W. Allen, J. K. Holloway and], Parasites of the Oriental Fruit Moth, 719
Haigh (Prof. B. P.), Riveted Joints and Welded Joints, 835
Håkansson (A.), Cytological Studies of Salix Hybrids, 464
Haldane (Prof. J. B. S.), Genetics of the Study of Development (*Review*), 413 ; Blood Groups of Anthropoids, 652
Halifax (Viscount), Edited by H. H. E. Craster, Speeches on Foreign Policy (*Review*), 789
Hall (Sir A. Daniel), The Genus Tulipa (*Review*), 379
Haller (K. W.), A New Bird from Virginia and its Fate, 463
Halliday (Dr. E. C.), [J. A. Pierce, A. J. Higgs and], Ionospheric Observations during the Solar Eclipse of October 1, 747
Hamann (C. W.), [F. J. Samuely and], Building Design and Construction : with reference to the New L.C.C. Regulations. Vol. 1 (*Review*), 347
Hamilton (J. E.), Common Salt as a Preservative, 133
Hammond (S. A. A.), appointed educational adviser on the West Indian Comptroller's staff, 399
Hanes (C. S.), [Dr. W. T. Astbury, Florence O. Bell and], X-Ray Comparison of Natural and Synthetic Starch, 558
Hanitsch (Dr. R.), [death], 224
Happey (Dr. F.), Calculation of Energy absorbed in Irradiated Tissue, 96
Harden (Sir Arthur), [obituary article], 122
Hardy (Prof. A. C.), Marine Ecology at Hull, 105 ; E. R. Gunther, 123
Hardy (Eric), *Siegesbeckia orientalis* in Britain, 688
Hardy (Prof. G. H.), awarded the Sylvester medal of the Royal Society, 679 ; work of, 751
Harger (H. S.), South African Stone Bead Industry, 235
Harington (C. R.), and R. C. G. Moggridge, Biogenesis of Vitamin B_1, 134
Harkins (Prof. W. D.), Dr. T. F. Young and E. Boyd, Energy and Entropy of Extension and Spreading of Mobile Monolayers, 406
Harland (S. C.), Polyploids in Cotton, 622
Harper (Dr. W. E.), [death], 88 ; [obituary article], 452
Harris (E. T.), Practical Science in Schools, 268
Harris (I. W. H.), [G. H. Cheesman, D. R. Duncan and], Sodium Polyiodides, 562
Harrison (Prof. G. R.), Atoms in Action : The World of Creative Physics (*Review*), 760
Harrison (G. R.), and N. Rosen, Spectrographic Analysis of Singly Ionized Praseodymium, 371
Harrison (H. H.), Telegraphic Typesetting, 713
Harrison (V. G. W.), The Science of Rheology, 580
Hart (Dr. C. A.), Air Photography applied to Surveying (*Review*), 572
Hart (F. C.), [death], 453
Hartley (Dr. G. S.), Electrical Effects at Chemical Boundaries (*Review*), 536
Hartley (H.), appointed lecturer in mine surveying in Leeds University, 715
Hartmann (Prof.), Acoustic Air-Jet Generator, 623
Hartree (Prof. D. R.), The Bush Differential Analyser and its Applications, 319
Hartshorn (Dr. L.), Electric and Magnetic Units (*Review*), 793
Harvey (Prof. J. W.), Prof. J. H. Muirhead, 18
Haswell (late Prof. W. A.), [late Prof. T. Jeffery Parker and], A Text-book of Zoology. Sixth edition. 2 Vols. Vol. 1, revised by Dr. O. Lowenstein (*Review*), 442
Hatfield (Dr. W. H.), Alloys of Iron and Chromium (*Review*), 506
Hawkes (C. F. C.), The Prehistoric Foundations of Europe to the Mycenean Age (*Review*), 213 ; Early Iron Age Burial, Bedfordshire, 370 ; [P. Corder and], Celtic Ornament from Elmswell, Yorks, 433
Hawkes (Dr. L.), A Cambridge Pleistocene Climate, 560
Hawkins (T. H.), Scientific Advancement (*Review*), 45 ; Elementary Biology (*Review*), 570
Hawley (I. M.), and F. W. Metzger, Feeding Habits of the Japanese Beetle, 306
Haworth (Prof. W. N.), J. Jackson and F. Smith, Properties of 3 : 6-Anhydrogalactose, 35
Hayes (Prof. C. J. H.), Novelty of Totalitarianism in the History of Western Civilization, 241
Hayes (E. H.), [death], 833
Hayhurst (H.), Insect Pests in Stored Products (*Review*), 757
Head (Sir Henry), [death], 516 ; [obituary article], 583
Heaslet (Prof. M. A.), [Prof. J. V. Uspensky and], Elementary Number Theory (*Review*), 418
Heatley (A. H.), Energy of Gaseous Molecules, 35
Heck (N. H.), Earthquakes of the U.S. Atlantic Coastal Plain, 307
Heilbron (I. M.), [L. C. Cross, C. G. Eliot, E. R. H. Jones and], Constituents of the Higher Fungi, 102
Hein (F.), and E. Nebe, Organic Compounds of Tungsten, 237
Heitler (H.), [Dr. C. F. Powell, Dr. F. C. Champion and], Neutron-Proton Scattering at High Energies, 716
Heitler (Drs. H. and W.), [Dr. C. F. Powell and], Absorption of Heavy Cosmic Ray Particles, 65
Heitler (Dr. W.), Dr. C. F. Powell and Dr. H. Heitler, Absorption of Heavy Cosmic Ray Particles, 65
Henderson (Prof. L. J.), What is Social Progress ?, 742
Henri (Prof. V.), [Prof. C. Weizmann, Dr. E. Bergmann and], Identification and Determination of Aromatic Compounds in Mineral Oils, 230
Herbert (A. P.), Let There be Liberty (*Review*), 409
Herrick (Prof. F. H.), [death], 740
Hescheler (Prof. K.), [death], 833
Hewlett (Prof. R. T.), Studies in Microbiology (*Review*), 149 ; [death], 395 ; [obituary article], 552
Hey (M. H.), British Museum (Natural History) Catalogue of Meteorites. Second Appendix, 196
Heymann (Dr. E.), [A. R. Docking, Lucy F. Kerley, K. N. Mortensen and], Evaporation of Water through Multimolecular Films, 265

Hibben (F. C.), Early Man and Pleistocene Deposits in America, 90
Hibert-Ware (Miss A.), The Fishing Heron, 235
Hickman (C. J.), Red Core Root Disease of Strawberry, 306
Higginbotham (R. S.), [W. A. Richardson and], Influence of combined Phosphoric Acid on the Swelling of Granular Starch, 234
Higgins (E.), Land Utilization and Fish Conservation, 206
Higgs (A. J.), [J. A. Pierce, Dr. E. C. Halliday and], Ionospheric Observations during the Solar Eclipse of October 1, 747
Higman (G.), The Symmetric Group in Mathematics (*Review*), 699
Hilgard (E. R.), awarded the Howard Crosby Warren medal of the Society of Experimental Psychology, 263
Hill (Sir Arthur), H. Guthrie-Smith, 158; awarded the George Robert White medal of the Massachusetts Horticultural Society, 684
Hill (Prof. A. V.), appointed a member of the advisory council to the committee of the Privy Council for Scientific and Industrial Research, 557
Hill (Prof. J. P.), awarded the Darwin medal of the Royal Society, 679; work of, 751; [Prof. T. T. Flynn and], Development of the Monotremata. Part IV, 339
Hill (R.), and R. Scarisbrick, Production of Oxygen by Illuminated Chloroplasts, 61
Hill (Prof. W. C. Osman), Classification of Hominidæ, 402; Folding of the External Ear of Lorisoid Monkeys, 494
Hind (H. Lloyd), Brewing: Science and Practice. Vol. 2: Brewing Processes (*Review*), 248
Hinshelwood (Prof. C. N.), The Kinetics of Chemical Change (*Review*), 603
Hoagland (Prof. D. R.), T. C. Broyer and P. R. Stout, Upward Movement of Salt in the Plant, 340
Hoare (Dr. C. A.), Indian Sporozoa (*Review*), 384
Hodgkinson (Jonathan), [obituary article], 55
Hodgson (E. A.), Bibliography of Seismology, April to June, 1940, 744
Hodsman (H. J.), Coke and its Properties (*Review*), 573
Hogben (Prof. L.), Principles of Animal Biology. Second edition (*Review*), 545
Holbœk (Dr. H.), Cultivated Crops in Early England, 754
Hole (Christina), English Folklore (*Review*), 215
Holloway (J. K.), [H. W. Allen, G. J. Haeussler and], Parasites of the Oriental Fruit Moth, 719
Holmes (Prof. A.), The Interior of the Earth (*Review*), 181
Holmstrom (Dr. J. E.), Records and Research in Engineering and Industrial Science: a Guide to the Production, Extraction, Integrating, Storekeeping, Circulation and Translation of Technical Knowledge (*Review*), 7
Hooke (Prof. S. H.), A New Translation of the Tell El-Amarna Letters (*Review*), 177
Hooper (F. H.), [death], 453
Hornell (J.), Bark Canoe, Dugouts and Plank-built Boats, 336
Horsley (W. D.), Operating Experience with High Voltage Alternators, 70
Hoshino (Y.), Genetical Studies on the Lady-Bird, 307
Howard (H. W.), and Dr. Irene Manton, Allopolyploid Nature of the Wild Tetraploid Watercress, 303
Howell (A. H.), [death], 224
Howitt (F. O.); [C. J. Cadwallader, S. G. Smith and], Reversibility of the Denaturation of Silk Fibroin, 301
Hoyle (Dr. F.), The Evolution of the Stars—a Correction, 458; [Dr. R. A. Lyttleton and], The Evolution of the Stars, 97
Hrdlička (Dr. A.), Amerindian Crania, 336; Bony Growths in the Human Jaw, 524
Huffer [Stebbins, Whitford and], Absorption of Light by Interstellar Matter, 810
Hughes (W.), [Dr. C. A. Beevers and], Crystal Structure of Rochelle Salt, 96
Hume-Rothery (W.), P. W. Reynolds and G. V. Raynor, Formation of 3/2 Electron Compounds in Alloys of Copper, Silver and Gold, 528
Hunsaker (Prof. J. C.), Friction and Surface Finish, 138
Huse (G.), [E. M. Jope and], Examination of 'Egyptian Blue' by X-Ray Powder Photography, 26
Hutchinson (F.), [obituary article], 484
Hutchinson (Dr. J.), Dr. J. Burtt-Davy, 424; awarded the Loder Rhododendron cup of the Royal Horticultural Society, 805
Hutchison (J. B.), Genetics and Plant-Breeding, 404
Hutt (F. B.), and W. F. Lamoreux, Genetics of the Fowl, 236
Hutton (Dr. Isabel Emslie), Mental Disorders in Modern Life: an Outline of Hopeful Treatment (*Review*), 547
Hutton (Dr. J. H.), Wolf-Children, 58
Huxley (Dr. Julian), The Sociology of Planning (*Review*), 3
Hyde (H. A.), and A. E. Wade, Welsh Ferns: a Descriptive Handbook, 743

Ikawa (M.), [Dr. Y. Nishina, T. Yasaki, H. Ezoe, Prof. K. Kimura and], Fission Products of Uranium produced by Fast Neutrons, 24
Iltis (Prof. H.), appointed professor of biology in Mary Washington College, Fredericksburg, Virginia, 775
Imms (Dr. A. D.), Grain Destruction by Insects, 238; Dr. R. Hanitsch, 360
Ince (Dr. E. L.), Integration of Ordinary Differential Equations (*Review*), 665
Inglis (Prof. C. E.), Alfred Stanley Chessum, 18
Irwin (M.), [M. P. Balfe, Dr. J. Kenyon and], Complex Rotatory Dispersion of Optically Active Tetrahydrofuryl-2-carbinol, 686
Ivens (Rev. Dr. W. G.), [death], 613; [obituary article], 645
Iyer (L. A. Krishna), The Travancore Tribes and Castes (*Review*), 8

Jacks (G. V.), The Drift from the Land (*Review*), 147; Conservation of the Soil (*Review*), 415
Jackson (J.), [Prof. W. N. Haworth, F. Smith and], Properties of 3: 6-Anhydrogalactose, 35
Jacobson [Angström and], Temperature Measurements in Vänern and Götaälv, 749
Jacoby (Dr. F.), Architecture of Colonies of a Pure Strain of Fibroblastic Sarcomatous Cells derived from a Dibenzanthracene Mouse Tumour, 301
James (Dr. F. Cyril), Science and Society, 171
James and James, Respiration in the Higher Plant, 783
Jameson (Sir W. Wilson), appointed a member of the Medical Research Council, 365; appointed chief medical officer of the Ministry of Health and the Board of Education, 684
Janaki-Ammal (E. K.), Chromosome Diminution in a Plant, 839
Jauncey (Prof. G. E. M.), and Prof. A. S. Langsdorf, M.K.S. Units and Dimensions and a proposed M.K.O.S. System (*Review*), 793
Jeans (Sir James), Are We Alone in the Universe? (*Review*), 211; An Introduction to the Kinetic Theory of Gases (*Review*), 535
Jenkin (Prof. C. F.), [death], 295
Jenkins (J. A.), [G. L. Stebbins and], Apomixis in Crepis, 34
Jenning (Dr. I.), appointed principal of the University College of Ceylon, 399
Jesse (W. P.), Cosmic Rays at High Altitudes, 527
Jewett (Dr. F. B.), resignation of the presidency of the Bell Telephone Laboratories, Inc.; appointed chairman of the board of directors, 834; and Dr. R. W. King, Engineering Progress and the Social Order, 824
John (D. Dilwyn), Crinoids from the "Discovery" Expedition, 236
Johnson (Dean J. B.), Johnson's Materials of Construction. Rewritten and revised by Prof. M. O. Withey and J. Aston. Eighth edition (*Review*), 286
Jones (C. R.), Damaged Starch and the Diastatic Activity of Flour, 202
Jones (D. Caradog), [T. W. Wyatt and], Post-War Poverty and Unemployment can be Prevented (*Review*), 312

Jones (E. R. H.), [L. C. Cross, C. G. Eliot, Prof. I. M. Heilbron and], Constituents of the Higher Fungi, 102
Jones (Prof. F. Wood), Attainment of the Upright Posture of Man, 26
Jones (G. Howard), and Abd El-Ghani Seif El-Nasr Eff, Control of Smut Diseases in Egypt with special reference to Sowing Depth and Soil Moisture, 135
Jones (Dr. H. Spencer), Sunspots during 1937, 136 ; Use of Eros to Determine the Solar Parallax, 203 ; Life on Other Worlds (*Review*), 211 ; The Total Solar Eclipse of October 1, 642
Jones (J. Pryce), and others, Rheology in Industry, 781
Jope (E. M.), and G. Huse, Examination of 'Egyptian Blue' by X-Ray Powder Photography, 26
Jourdain (late Rev. F. C. R.), [H. F. Witherby, N. F. Ticehurst, B. W. Tucker and], The Handbook of British Birds. Vol. 4 : Cormorants to Crane (*Review*), 411
Jubb (R. A.), Meteorological Report for Southern Rhodesia for year ending June 30, 1939, 127
Jung (Dr. C. G.), translated by S. M. Dell, The Integration of the Personality (*Review*), 533

Kalmbach (E. R.), The English Sparrow in the United States, 524
Kanai (K.), [K. Sezawa and], Plasticity Conditions for the Formation of Faults, 307
Kantor (J. H.), [T. M. Little, B. H. Robinson and], Genetics and Long-day Plants, 135
Kay (Prof. H. D.), and others, Cheese Making : Scientific Research and Control, 796
Kearton (Cherry), [death], 453
Keble (R. A.), and Prof. W. N. Benson, Graptolites of Australia, 561
Keele (C. A.), and H. H. Kwiatkowski, Concentrated Plasma in Histamine Shock, 32
Keevil (N. B.), Interatomic Forces and Helium in Rocks, 656
Keifer (Dr.), Eriophyidæ or 'Gall-Mites', 464
Keilin (Prof. D.), [Dr. T. Mann and], Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase, 164 ; [W. Feldberg, Dr. T. Mann and], Activity of Carbonic Anhydrase in relation to Gastric Secretion, 651 ; and Dr. Mann, Carbonic Anhydrase, 779
Kellogg (C. E.), Nutrition of Fur Animals, 364
Kelly (J. P.), Irregular Flowers in Phlox, 34
Kemble (E. C.), The Probability Concept, 464
Kenneth (Dr. J. H.), Average Gestation Period and $n\pi$, 620
Kenyon (Dr. J.), [M. P. Balfe, M. Irwin and], Complex Rotatory Dispersion of Optically Active Tetrahydrofuryl-2-carbinol, 686
Kerley (Lucy F.), [A. R. Docking, Dr. E. Heymann, K. N. Mortensen and], Evaporation of Water through Multimolecular Films, 265
Kerr (Sir John Graham), Camouflage in its Application to Ships at Sea, 161
Kerr, Shannon and Arnold, Vibration of Propeller Blades, 843
Kerridge (Dr. Phyllis M. Tookey), [obituary article], 159
Kerry (W. H.), and E. W. Stott, Freehand Drawing and Pictorial Illustration for Draughtsmen, 457
Kidston (E. B.), Magnesium Deficiency in Apple Leaves, 337
Kiefer (Dr. F.), Indian Copepods, 591
Kiehl (S. J.), [O. E. Lanford and], Basic Nature of Vanadium Pentoxide, 525
Kimbell (G. E.), Directed Valency, 69
Kimura (Prof. K.), [Dr. Y. Nishina, T. Yasaki, H. Ezoe, M. Ikawa and], Fission Products of Uranium produced by Fast Neutrons, 24
Kindle (E. M.), [death], 360
King (Cuthbert), Rock Engravings on the Indus, 101
King (Dr. R. W.), [Dr. F. B. Jewett and], Engineering Progress and the Social Order, 824
Kinnear (N. B.), South African Birds (*Review*), 345
Kinney (W. F.), [E. T. Cope and], Heat Insulation in Electric Power Stations, 844
Kinzel (A. B.), and R. Franks, The Alloys of Iron and Chromium. Vol. 2 : High-Chromium Alloys (*Review*), 506
Kingzett, Chemical Encyclopædia : a Digest of Chemistry and its Industrial Applications, revised and edited by Prof. R. K. Strong. Sixth edition (*Review*), 280
Kirkman (F. B.), Nesting Conventions of the Black-headed Gull, 655
Kistiakowsky (G. B.), and A. Cramer, Synthesis of Radioactive Lactic Acid, 562
Klein (F.), translated by E. R. Hedrick and Prof. C. A. Noble, Elementary Mathematics from an Advanced Standpoint : Geometry (*Review*), 78
Kligler (Prof. I. J.), and N. Grossowicz, Function of Nicotinic Acid in the Metabolism of the Colon-Typhoid Group of Bacteria, 652
Kluge (R. W.), Tests of Structural Hinges of Reinforced Concrete, 276
Knaggs (Dr. I. E.), [Dr. K. Lonsdale, H. Smith and], Diffuse Reflection of X-Rays by Single Crystals, 332
Knowles (Dr. F. G. W.), Response of Isolated White Chromatophores of Crustacea to Change of Illumination, 131
Knox (Monsignor Ronald), Nazi and Nazarene (*Review*), 409
Koch (Dr. F. C.), appointed Frank P. Hixon distinguished service professor of chemistry in Chicago University, 93
Kodani (M.), [M. Calvin, R. Goldschmidt and], Salivary Gland Chromosomes, 269
Kohn (Prof. H.), Totalitarian Philosophy of War, 241
Kopaczewski (W.), Essai de météoropathologie : Physique, clinique, thérapeutique (*Review*), 250
Kostitzin (V. A.), translated by T. H. Savory, Mathematical Biology (*Review*), 444
Kostoff (Dr. D.), appointed to a post in the Central Agricultural Experiment Station at Sofia, 715
Kothari (Dr. D. S.), Mass-Radius Relation for a White Dwarf Star, 24
von Krafft-Ebing (Prof. R.), centenary of the birth of ; work of, 194
Krantz, jun. (Dr. J. C.), [Dr. Ruth Musser and], William Withering and Erasmus Darwin, 398
Krishnan (Prof. K. S.), S. L. Chorghade and T. S. Ananthapadmanabhan, Dimorphism of Diphenyl Octatetraene Crystals, 333
Krishnamurthy (P. V.), [K. V. Giri and], Co-existence of Oxidizing and Protective Mechanisms for Vitamin C. in Plant Tissues, 99
Krogman (Dr. W. M.), Racial Characters in Ancient India, 262
Kroner (Dr. R.), appointed professor of logic and metaphysics in McGill University, Montreal, 59
Kudo (Prof. R. R.), Protozoology (*Review*), 80
Kükenthal (Prof. W.), Herausgegeben von Dr. T. Krumbach, Handbuch der Zoologie, Band 3 : Hälfte 2, Lief. 12 ; Band 3: Hälfte 2, Lief. 13 (*Review*), 504
Kulik (L. A.), Catalogue of Meteorites of the U.S.S.R., 804
Kwiatkowski (H. H.), [C. A. Keele and], Concentrated Plasma in Histiamine Shock, 32

Labarthe (Dr. André), appointed director-general of French services connected with armaments and scientific research in Great Britain, 23 ; work of, 89 ; Les Français de Grande Bretagne, 329
Lack (D.), Evolution of the Galapagos Finches, 324 ; House-Sparrow in New Environment, 809
Laidler (D.), [A. Taylor and], Anomalous Diffractions in the Hull-Debye-Scherrer Spectrum of Graphite, 130
Lakhovsky (G.), translated by N. Clement, The Secret of Life : Cosmic Ways and Radiations of Living Beings (*Review*), 538
Lamoreux (W. F.), [F. B. Hutt and], Genetics of the Fowl, 236
Landen (E. W.), Inactivation of an Enzyme, 690
Lanford (O. E.), and S. J. Kiehl, Basic Nature of Vanadium Pentoxide, 525

Lang (W. D.), S. Smith and H. D. Thomas, Index of Palæozoic Coral Genera, 195
Langevin (Prof. P.), awarded the Copley medal of the Royal Society, 679; work of, 750; imprisonment of, 715
Langsdorf (Prof. A. S.), [Prof. G. E. M. Jauncey], M.K.S. Units and Dimensions and a Proposed M.K.O.S. System (*Review*), 793
Langton (H. H.), Sir John Cunningham McLennan. With a chapter on his scientific work by Prof. E. F. Burton (*Review*), 111
Lark-Horovitz (Prof. K.), and E. P. Miller, Structure of Liquid Argon, 459
Larmor (Sir Joseph), Origins of Electric Transmission by Resonance, 459
Lasnitzki (Dr. A.), Potassium and Carbohydrate Metabolism, 99; and Dr. A. K. Brewer, Increase of Heavy Potassium in Plasma, 807
Laurie (Prof. A.), Soilless Culture Simplified (*Review*), 633
Lawrence (Dr. A. S. C.), Review of two books on Photography, 350; Dr. J. Needham and Dr. Shih-Chang Shen, Relations between Molecular and Morphological Shape of Protein Solutions, 104
Lawrence (P. S.), Ancestral Longevity and the Sex Ratio, 655
Layman (J. W.), Children under Foster Care, 262
Lea (D. E.), Determination of the Sizes of Viruses and Genes by Radiation Methods, 137
Lea (Dr. F. M.), award to, from the Beilby Memorial Fund; work of, 771
Lebour (M. V.), [R. Gurney and], Crustacean Larvæ, 404
Ledingham (Sir John), Sir Arthur Harden, 122; Prof. R. T. Hewlett, 552
Leet (L. D.), and T. J. Smith, Determination of the Depth of Glacial Deposit, 810
Legget (Prof. R. F.), Geology and Engineering (*Review*), 699
Lennox (F. G.), Distribution of Ammonia in Leaves of *Lucilia cuprina*, 268
Lerner (I. M.), [Dr. J. Needham and], Terminology of Relative Growth-Rates, 618
Lester (Major R. M.), Weather Prediction (*Review*), 818
Levene (Dr. P. A. T.), [death], 740
Levy (Prof. H.), Science—Curse or Blessing ? (*Review*), 176; War and Industrial Injuries, 242
Lewis (Dr. A. B.), [death], 833
Lewis (D.), Selective Fertilization in the Raspberry, 135
Lewis (G. L.), [C. P. Smyth, A. J. Grossman, F. B. Jennings and], Dipole Moments and Structures, 136
Lewis (Dr. N. D. C.), Mental Hygiene of Old Age, 650
Lewis-Faning (Dr.), Seasonal Mortality in England and the United States, 126
Licéaga (Edoardo), centenary of the birth of, 59
Limaye (V. D.), Strengths of Indian Timbers, 228
Lin (Dr.), Fisheries Research in Hong Kong, 207
Lindley (Prof. E. H.), [death], 516
Lindsay (E.), Biology of the Silverfish Insect, 67
Lindsay (Sir Harry), Work of the Imperial Institute, 626
Link (H. L.), and L. J. Wood, Reactions between Dry Salts, 237
Lipson (Dr. H.), Application of X-Rays to the Study of Alloys, 798
Little (L. S.), centenary of the birth of; work of, 682
Little (T. M.), J. H. Cantor and B. H. Robinson, Genetics and Long-day Plants, 135
Littler (Dr. T. S.), Effect of Noises of Warfare on the Ear, 217
Littleton (Dr. J. T.), Softening Point of Glass, 810
Littlewood (Prof. D. E.), The Theory of Group Characters and Matric Representations of Groups (*Review*), 699
Liu (Chungshee H.), Li Tribes of Hainan Island, 202
Lloyd (A. J.), and Prof. C. M. Yonge, Correlation between Egg-carrying Setæ and Cement Glands in Decapod Crustacea, 334
Lloyd (Ll. S.), The Musical Ear (*Review*), 476
Lloyd (Lord), Colonial Policy During and After the War, 833
Lobeck (Prof. A. K.), Geomorphology: an Introduction to the Study of Landscapes (*Review*), 445
Lodge (Sir Oliver), [death], 295; [obituary article], 327
Loeb (Prof. L. B.), Fundamental Processes of Electrical Discharge in Gases (*Review*), 729
Loeffler (Sister M. Kenneth), [Prof. J. C. Fardon, Rev. G. Brotzge, Juanita Breit and], Attraction Fields *in vitro*, 619
Loeser (late Dr. J. A.), Animal Behaviour: Impulse, Intelligence, Instinct (*Review*), 317
Loew (E. A.), Direct and Alternating Currents: Theory and Machinery. Second edition (*Review*), 668
Logan (Dr. M. A.), appointed Andrew Carnegie professor of biochemistry in the College of Medicine of Cincinnati University, 490
Long (J. S.), and H. V. Anderson, Chemical Calculations. Fourth edition (*Review*), 545
Lonsdale (Dr. Kathleen), Diffuse Reflections on Laue Photographs, 806; Dr. I. E. Knaggs and H. Smith, Diffuse Reflection of X-Rays by Single Crystals, 332
Loomis (C. Grant), Hagiological Healing, 20
Lorenzini (Count Giovanni), [death], 257
Love (Prof. A. E. H.), [obituary article], 393; correction, 458
Lowe (Prof. C. van Riet), Snake Vessel from South-Central Africa, 370
Lowery (Dr. H.), Education of Workers in Applied Physics, 811
Lowndes (A. G.), Practical Science in Schools, 133
Luciani (Prof. L.), centenary of the birth of; work of, 681
Luck (Dr. D.), A new Direction Indicator for an Aeroplane, 299
Luckett (Miss B.), and F. Smith, Constitution of Pectic Acid, 525
Lundstedt [Baxter and], Atomic Weight of Iodine, 405
Lythgoe (Dr. R. J.), [obituary article], 190
Lyttleton (Dr. R. A.), Origin of the Solar System, 310; and Dr. F. Hoyle, The Evolution of the Stars, 97

Maby (J. C.), and T. B. Franklin, The Physics of the Divining Rod (*Review*), 150
McAlister (E. D.), and J. Myers, Photosynthesis and Fluorescence, 621
McAtee (W. L.), Attracting Birds, 21
MacBride (Prof. E. W.), [death], 678; [obituary article], 831
McCalla (Dr. A. G.), and N. Gralén, Gluten Protein, 60
McCallum (Dr. S. P.), [death], 678; [obituary article], 740
McCollum (Prof. E. V.), Inorganic Elements in Nutrition, 658
MacCurtin (T.), and Prof. J. Reilly, Sclerotiorine, a Chlorinated Metabolic Product of *Penicillium Sclerotiorum*, Van Beyma, 335
Macdonald (Sir George), [death], 224; [obituary article], 257
Macdougall (Prof. F. H.), Thermodynamics and Chemistry. Third edition (*Review*), 631
McDougall (F. L.), Food and Welfare (*Review*), 243
McFarland (Brig.-Genl. E.), Evolution of Weapon Types and Design, 774
MacGregor-Morris (Prof. J. T.), The Arc as a Standard of Light, 555
Machle (W.), and E. E. Evans, Exposure to Fluorine in Industry, 330
McIlwain (H.), Pyridine-3-sulphon-(2-pyridil)-amide: a Note on the Modelling of Chemotherapeutic Agents, 653
MacInnes (Dr. D. A.), The Principles of Electrochemistry (*Review*), 534
McIntosh (R. A.), Seasonal Variation in the Height of Meteors, 271
Mack (Prof. J. E.), and Prof. M. J. Martin, The Photographic Process (*Review*), 350
McKenna (N. A.), Theoretical Electrochemistry (*Review*), 534
MacLagan (D. S.), Sunspots and Insect Epidemics, 748
Macleod (Col. Kenneth), centenary of the birth of; work of, 90

McMath (Dr. R. R.), The McGregor Building and Tower Telescope of the McMath-Hulbert Observatory, 287
MacNalty (Sir Arthur), Well-Being of Munition Workers (*Review*), 599; retirement of, from the Ministry of Health and the Board of Education, 684
McNaughton (Major-Genl. A. G. L.), Report of the National Research Council of Canada, 106
Madinaveitia and others, Diffusing Factors, 68
Madinaveitia (J.), Prof. A. R. Todd, A. L. Bacharach and M. R. A. Chance, Mucolytic Activity of Diffusing Factor Preparations, 197
Mal (S.), [B. N. Desai and], Thunderstorms at Karachi, 136
Malott (Prof. D. W.), and B. F. Martin, The Agricultural Industries (*Review*), 504
Mangelsdorf (Dr. P. C.), appointed professor of botany in Harvard University and assistant director of the Botanical Museum, 300; Origin of Maize, 338
Mani (M. S.), [Hem Singh Pruthi and], Indian Parasitic Chalcidoidea, 235
Mann (F. G.), [J. Chatt and], Phosphonium, Arsonium and Stibonium Salts, 525
Mann (Dr. T.), and Prof. D. Keilin, Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase, 164; [W. Feldberg, Prof. D. Keilin and], Activity of Carbonic Anhydrase in relation to Gastric Secretion, 651; [Prof. Keilin and], Carbonic Anhydrase, 779
Mannheim (Prof. K.), translated by E. Shils, Man and Society in an Age of Reconstruction: Studies in Modern Social Structure. With a bibliographical guide to the study of "Modern Society" (*Review*), 3
Mansell (Major R. A.), Health on Gibraltar, 744
Mansfield (W.), Farming as a Business (*Review*), 601
Manton (Dr. Irene), [H. W. Howard and], Allopolyploid Nature of the Wild Tetraploid Watercress, 303
Marett (Lt.-Commdr. J. R. de la H.), [obituary article], 88
Marett (Dr. R. R.), Realism and Idealism in the Study of Man, 37; Cave Worship, 229; Culture of the Nuer (*Review*), 568
Marhic (Dr. Y. M.), Leprosy in Brittany, 684
Mark (Dr. H.), appointed professor of organic chemistry in the Polytechnic Institute of Brooklyn, 263; and Dr. R. Simha, Viscosity and Molecular Structure, 167
Marks (H. P.), and Dr. F. G. Young, Species Variation in the Insulin Content of Pancreas, 31
Marrack (Prof. J. R.), Medicine in War-time, 577
Marshall (Dr. F. H. A.), Embryological History (*Review*), 348; The Physiology of Reproduction (*Review*), 502; awarded a Royal medal of the Royal Society, 679; work of, 751; Sexual Display in Birds (*Review*), 794
Marshall (R. C.), Silviculture of the Trees of Trinidad and Tobago, British West Indies (*Review*), 546
Martin (A. J. P.), and R. L. M. Synge, Volatile Aldehydes Liberated by Periodic Acid from Protein Hydrolysates, 491
Martin (B. F.), [Prof. D. W. Malott and], The Agricultural Industries (*Review*), 504
Martin (Dr. H.), Spreading of Spray Fluids, 135; The Scientific Principles of Plant Protection: with special reference to Chemical Control. Third Edition (*Review*), 569
Martin (Lieut. J. H.), [obituary article], 553
Martin (Col. L.), Early Explorers of Southern South America from the United States, 238
Martin (Prof. L. C.), Ultra-Violet and Electron Microscopy, 288
Martin (Prof. M. J.), [Prof. J. E. Mack and], The Photographic Process (*Review*), 350
Martin (R. A.), Ancient Seals of the Near East, 455
Marton (Dr. L.), and Dr. V. K. Zworykin, A New Electron Microscope, 35
Marvin (F. S.), History and Science (*Review*), 179; 316; Marxism in History Exposed (*Review*), 600
Marwick (B. A.), The Swazi: an Ethnographic Account of the Natives of the Swaziland Protectorate (*Review*), 380
Marx (F. M.), Totalitarian Politics, 241
Mason (E. W.), [G. R. Bisby and], Pyrenomycetes recorded for Britain, 748
Mason (Dr. J. Alden), Pre-Columbian Burial in Panama, 330
Mason (Margery), [Alice Crang and], "Growmore" Bulletin, No. 3, 260
Mason (P. W.), American Aphids of the Genus Myzus, 135
Mason [Phillis and], Translocation of Minerals in Cotton, 779
Massey (Prof. H. S. W.), [Dr. C. B. O. Mohr and], Polarization of Electrons by Double Scattering, 264; and Dr. R. A. Buckingham, Collisions of Neutrons with Deuterons and the Nature of Nuclear Forces, 776
Mather (Dr. K.), [Prof. R. A. Fisher and], Non-Lethality of the Mid Factor in *Lythrum Salicaria*, 521
Mathisson (Dr. M.), [death], 584; [obituary article], 613
Matthews (F. A.), A Flooded Power Station, 364
Matthews (Prof. J. R.), Water Plants (*Review*), 700
Matukuma (Prof. T.), Derivation of Einstein Effect from Eclipse Observations of 1936, 264
Mawer (A.), [J. E. B. Gover, F. M. Stenton and], The Place-Names of Nottinghamshire (*Review*), 820
Mayneord (Dr. W. V.), conferment upon, of the title of professor by London University, 263; 805
Meacher (J. L.), Trephining in New Britain, 433, 617
Meade (J. E.), The Economic Basis of a Durable Peace (*Review*), 243
Mehta (Dr. K. C.), and Dr. B. P. Pal, Rust-Resistant Wheats for India, 98
Mellanby (Dr. K.), Temperature Coefficients and Acclimatization, 165
Mellor (late Dr. J. W.), and H. V. Thompson, A Treatise on Quantitative Inorganic Analysis: with special reference to the Analysis of Clays, Silicates and Related Minerals. Second edition (*Review*), 385
Melmore (S.), Symmetrical Arrangement of Equal Spheres, 199; The Generalized Kaleidoscope, 232
Melsom (S. W.), Standardizing Electric Distribution Cables, 22
Melville (Dr. H. W.), Practical Physical Chemistry (*Review*), 5
Melville (Dr. R.), Wild Seeds as Animal Feeding-Stuffs, 403
Merriman (Dr. A. D.), award to, of the George Cross, 744
Merton (Prof. T. R.), Camouflage in Modern Warfare, 429
Merz (Dr. C. H.), [death], 584; [obituary article], 613
Metz (C. W.), Evolutionary Chromosome Change in Sciara, 306
Métraux (A.), Ethnology of Easter Island, 465
Metzger (F. W.), [I. M. Hawley and], Feeding Habits of the Japanese Beetle, 306
Meyer (Prof. A. W.), The Rise of Embryology (*Review*), 348
Meyerhof (Miss Elizabeth), and Hon. Miriam Rothschild, A Prolific Trematode, 367
Meyerowitz (Eva L. R.), Pre-Portuguese Bronze Castings from Benin, 463
Mill (Dr. H. R.), R. C. Mossman, 359
Miller (A. A.), Geomorphology (*Review*), 445
Miller (E. P.), [Prof. K. Lark-Horovitz and], Structure of Liquid Argon, 459
Miller (Prof. H.), History and Science: a Study of the Relation of Historical and Theoretical Knowledge (*Review*), 316
Miller (Dr. K. E.), Public Health and Advertising, 456
Miller (Prof. W. Lash), [death], 328
Milligan (W. O.), [H. B. Weiser and], Precipitation of Colloids by Electrolytes, 622
Millikan (Prof. R. A.), Origin of Cosmic Rays, 804
Mills (late Prof. A. P.), Materials of Construction: their Manufacture and Properties. Second, third and fourth editions, edited by H. W. Hayward. Fifth edition, rewritten and edited by Prof. L. F. Rader (*Review*), 286
Milne (A.), Ecology of the Estuary of the Aberdeenshire Dee, 135
Milne (A. A.), War with Honour (*Review*), 409
Milne (Prof. E. A.), Sir J. J. Thomson, 356; Prof. A. E. H. Love, 393
Milward (Marguerite), Jungle People of Travancore (*Review*), 8
Mimno (H. R.), [J. A. Pierce and], Radio Echoes and Fading, 34

Minder (Dr. W.), Isolation of Element 85, 225
Miser (Dr. H. D.), Oilfields of the United States, 437
Mitchell (Dr. J. S.), Increase in Ultra-Violet Absorption of Cytoplasm after Therapeutic X- and Gamma-Irradiation, 272
Mitchell (Sir P. Chalmers), The Duke of Bedford, 394
Mitchell (Dr. W. C.), Economic Resources and their Employment, 575
Moggridge (R. C. G.), [C. R. Harington and], Biogenesis of Vitamin B_1, 134
Mohr (Dr. C. B. O.), and Prof. H. S. W. Massey, Polarization of Electrons by Double Scattering, 264
Mond (late Sir Robert), and O. H. Myers; with chapters by Miss M. S. Drower, D. B. Harden, S. A. Huzayyin, R. E. McEuen and Mary I. C. Myers. Temples of Armant: a Preliminary Survey, Text and Plates (*Review*), 664
Moore (Charlotte E.), [Prof. H. N. Russell and], Masses of the Stars, 103
Moore (Dr. H.), Window Breakage by Bomb Blast, 657
Moore (W. C.), New Plant Diseases, 337
Moore-Brabazon (Lt.-Col. J. T. C.), appointed Minister of Transport, 554
Moran (Dr. T.), and Prof. J. C. Drummond, Reinforced White Flour, 117
Moreau (R. E.), and R. H. W. Pakenham, Faunistics and Ages of the East African Islands, 462
Morley (Dr. A.), Strength of Materials. Ninth edition (*Review*), 386
Mortensen (K. N.), [A. R. Docking, Dr. E. Heymann, Lucy F. Kerley and], Evaporation of Water through Multimolecular Films, 265
Mortensen (T.), Echinoidea of the Murray Expedition, 33
Mortimer (F. J.), and others, Edited by Dr. O. Bloch, The Photographer Speaks (*Review*), 350
Moses (S. T.), Vaghers of Okhamandal, 269
Moss (B. P.), [W. K. Brasher and], Supersonic Signal Method for Telephone Calls, 300
Moss (H. P.), Stone Implements from Canberra, Australia, 269
Mossman (R. C.), [death], 257; [obituary article], 359
Mott (Dr. R. A.), and late Prof. R. V. Wheeler, The Quality of Coke: being the Second Report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council (*Review*), 573
Moutia (L. A.), Parasites of Chafer Larvæ in Africa and France, 306
Muirhead (Prof. J. H.), [obituary article], 18
Muller (Dr. H. J.), Structural Changes in the Chromosomes of Drosophila, 236; and Dr. G. Pontecorvo, Recombinants between Drosophila Species the F_1 Hybrids of which are Sterile, 199
Mullins (C.), The Illegitimate Child, 298
Munro (Prof. J. W.), Entomology of Stored Products (*Review*), 757
Murnaghan (Prof. F. D.), The Theory of Group Representations (*Review*), 283
Murray (D.), Telegraphic Typesetting, 713
Muskett (A. E.), and J. Colhoun, Prevention of Seedling Blight in the Flax Crop, 32; and E. L. Calvert, Blind Seed Disease of Rye-Grass, 200
Musser (Dr. Ruth), and Dr. J. C. Krantz, Jun., William Withering and Erasmus Darwin, 398
Myers (Dr. C. S.), Prof. C. G. Seligman, 515
Myers (J.), [E. D. McAlister and], Photosynthesis and Fluorescence, 621
Myers (O. H.), [late Sir Robert Mond and; with chapters by Miss M. S. Drower, D. B. Harden, S. A. Huzayyin, R. E. McEuen and Mary I. C. Myers], Temples of Armant: a Preliminary Survey. Text and Plates (*Review*), 664
Myres (Prof. J. L.), papers presented to, in honour of his 70th Birthday (The Annual of the British School at Athens. No. 37, Session 1936–37) (*Review*), 505

Nadel (S. F.), Glass-making in Nupe, Nigeria, 134
Nagelschmidt (Dr. K. F.), Biological Effects of High-Frequency and Magnetic Fields, 590
Nagy (I.), Gypsies of the Sárrét (Hungary), 305
Nakazima (Y.), Impregnation of Poles with Copper Sulphate, 495
Nebe (E.), [F. Hein and], Organic Compounds of Tungsten, 237
Needham (Dr. J.), correction of a misprint in NATURE of July 20, p. 104, 399; Recent Impressions of War-time America, 737; [Dr. A. S. C. Lawrence, Dr. Shih-Chang Shen and], Relations between Molecular and Morphological Shape of Protein Solutions, 104; and I. M. Lerner, Terminology of Relative Growth-Rates, 618
Nelson (Prof. J. R.), Writing the Technical Report (*Review*), 419
Neuberg (Prof. C.), appointed research professor of chemistry in the Washington Square College of Arts and Sciences of New York University, 365
Neugebauer (Dr. O.), Exact Science in Antiquity, 625
Neville (Prof. E. H.), Sir J. J. Thomson, 357
Newman (Sir George), Physical Education in Great Britain, 115
Newton (Prof. J. H.), Education for Democracy in our Time (*Review*), 696
Nicholls (Lt.-Col. T. B.), with chapters by Air-Commodore A. S. Glynn, Col. A. R. Laurie and Col. F. G. Lescher, Organization, Strategy and Tactics of the Army Medical Services in War. Second edition (*Review*), 314
Nicholson (E. M.), and J. Fisher, Birds on St. Kilda, 235
Nicholson (Prof. H. H.), [death], 516
Nicol (Dr. H.), Soil Bacteria and War Wounds, 723
Nilakantan (P.), [Sir C. V. Raman and], Modified Reflection of X-Rays, 523; Classical and Quantum Reflections of X-Rays in Crystals, 686
Nilsson-Leissner (S.), and others, Breeding of Herbage Plants in Scandinavia and Finland, 22
Nishina (Dr. Y.), T. Yasaki, H. Ezoe, Prof. K. Kimura and M. Ikawa, Fission Products of Uranium Produced by Fast Neutrons, 24; Y. Sekido, H. Simamura and Dr. H. Arakawa, Cosmic Ray Intensities in relation to Cyclones and Anticyclones, 95
Noble (M.), [Dr. M. Wilson, E. G. Gray and], Blind Seed-Disease of Rye-Grass, 492
Nolan (J. J.), Ionization of the Lower Atmosphere, 720
Nordenmark (N. V. E.), Pehr Wilhelm Wargentin (*Review*), 477
Nordman (C.), [death], 678
North (Dr. F. J.), and W. F. Grimes, The Legend of Llys Helig—its Origin and Significance, 455
Northfield (D. W. C.), and others, Special Surgery in War-time (*Review*), 822
Notter and Firth's Hygiene, revised by L. C. Adam and E. J. Boome. Tenth edition (*Review*), 547

Ochoa (Dr. S.), Nature of Oxidative Phosphorylation in Brain Tissue, 267
O'Donoghue (Prof. C. H.), A Zoology for Students (*Review*), 442
Ogden (Mrs. J. R.), and Family, Gift to the Brotherton Library of Leeds University, 715
Ogilvie (W. H.), and others, War Primer on Wound Infection: Its Causes, Prevention and Treatment, 753
Oldroyd (H.), [Dr. F. W. Edwards, Dr. J. Smart and], British Blood-Sucking Flies (*Review*), 447
Orton (Prof. J. H.), Research at Port Erin, 58

Page (J. C.), Role of Reclamation in Conservation, 204
Pakenham (R. H. W.), [R. E. Moreau and], Faunistics and Ages of the East African Islands, 462
Pal (Dr. B. P.), [Dr. K. C. Mehta and], Rust-resistant Wheats for India, 98
Panikkar (N. K.), Influence of Temperature on Osmotic Behaviour of some Crustacea and its bearing on Problems of Animal Distribution, 366
Panse (V. G.), Genetics and Plant-Breeding, 404
Pape (N. R.), [C. S. Fuller, C. J. Frosch and], Polyisobutylene, 656
Parker (F. D.), Costs of Electrical Heating, 814

Parker (G. H.), Fats and Oils as Protective Repositories of Neurohumors and other Chemical Activators, 561
Parker (late Prof. T. Jeffery), and late Prof. W. A. Haswell. A Textbook of Zoology. Sixth edition. 2 Vols. Vol. 1, revised by Dr. O. Lowenstein (*Review*), 442
Parkes (Dr. H. B.), Marxism : a Post-Mortem (*Review*), 508
Parrington (F. R.), and T. S. Westoll, Evolution of the Mammalian Palate, 655
Parsons (Sir John Herbert), Planning the Peace, 230 ; Night-Shining Eyes, 366
Parsons (R. H.), The Early Days of the Power Station Industry (*Review*), 146
Partington (Prof. J. R.), Thermodynamics and Chemistry (*Review*), 631
Pascoe (F. J.), Fitness in Industry, 585
Paterson (T. T.), Geology and Early Man, I, 12 ; II, 49
Paulian (R.), A French Expedition to the Cameroon Mountains, 85
Pauling (L.), Structure and Formation of Antibodies, 464
Paulraj (Dr. M.), [Dr. R. G. Cochrane, Miss M. D. Salmond and], Wheat Diet and Leprosy, 497
Peacock (Prof. A. D.), A possible case of Polyploidy in a Prosobranch Mollusc, 368
Peacock (Prof. D. H.), impending retirement from the service of the Government of Burma, 715
Peacock (P. R.), and R. I. Shukoff, Use of Desiccated Chick Embryo in Tissue Culture Technique, 30
Peake (H. J. E.), The Study of Prehistoric Times (Huxley memorial lecture), 763
Pearl (Prof. R.), Jewish-Christian Intermarriages in Budapest, 20 ; Body Build, 33 ; Ageing of Populations, 36 ; New World Populations, 772, 783
Pearson (A. R.), Radiation and 'Stuffiness', 232
Peck (Dr. A. L.), Daylight Observation of Venus and Jupiter, 162
Peddie (Prof. W.), Colour Vision and Chromaticity Scales, 717
Penniman (T. K.), Lt.-Commdr. J. R. de la H. Marett, 88
Pepere (Prof. A.), [death], 833
Petch (T.), Tubercularia Fungi, 434
Peters (Prof. R. A.), Cocarboxylase, 387
Petersen (Dr. Jacob Julius), centenary of the birth of; work of, 834
Peto (H.), and J. W. Boyes, Triploid Sugar Beet, 748
Petrauskas (A.), [C. H. Cartwright, J. Daniel and], Infra-Red Transmission of the Human Body, 591
Petrie (Dr. G. F.), Prof. Hans Zinsser, 516 ; Memoirs of an Immunologist (*Review*), 761
Petrova (Prof. Maria K.), awarded the Pavlov prize by the Academy of Sciences of the U.S.S.R., 490
Petrovič (Dr. A.), Disappearance of Serbian Gypsies, 336
Philip (Prof. J. C.), elected president of the Society of Chemical Industry, 458
Phillis and Mason, Translocation of Minerals in Cotton, 779
Physick (Philip Syng), (1768–1837), 20
Pierce (J. A.), and H. R. Mimno, Radio Echoes and Fading, 34 ; A. J. Higgs and Dr. E. C. Halliday, Ionospheric Observations during the Solar Eclipse of October 1, 747
Piercy (Dr. N. A. V.), awarded a Leverhulme research fellowship, 93
Piggott (S.), Trepanning in Prehistoric Europe, 616; 621
Pikovski (M.), [Prof. L. Doljanski and], Cultivation of the agent of Fowl Leukosis *in vitro*, 302
Pimputkar (M. G.), awarded the Sir John William Lubbock memorial prize of London University, 805
Pinchot (Hon. G.), Conservation as a Foundation of Permanent Peace, 183 ; work of, 191
de Pino (L.), Native Medicine in Portuguese Africa, 67
Pirie (N. W.), appointed head of the biochemical section of the Rothamsted Experimental Station ; work of, 554
Pitoux (Dr. H.), Treatment of Juvenile Delinquents, 298
Pitt (Miss Frances), How to See Nature (*Review*), 350
van der Plank (J. E.), Control of Moulds on Citrus Fruit, 370
Platenius (H.), Preservation of Vegetables by Waxing, 102
Plaut (Prof. Felix), [obituary article], 190
Plimmer (Violet G.), Nutrition in the Home (*Review*), 727
Plummer (Prof. H. C.), Probability and Frequency (*Review*), 114 ; Contributions to the History of Science (*Review*), 247 ; Copernican Literature (*Review*), 343 ; A Great Swedish Astronomer (*Review*), 477
Polanyi (Prof. M.), [E. T. Butler and], Influence of Substitution on Organic Bond Strength, 129 ; [E. C. Baughan and], Energy of Aliphatic Carbon Links, 685
Pole (Sir Felix), appointed a member of the advisory council to the committee of the Privy Council for Scientific and Industrial Research, 557
Polson (Prof. R. A.), [Prof. Dwight Sanderson and], Rural Community Organization (*Review*), 385
Pólya (Prof. G.), appointed to the department of mathematics in Brown University, 805
Pontecorvo (Dr. G.), [Dr. H. J. Muller and], Recombinants between Drosophila Species the F_1 Hybrids of which are Sterile, 199
Pontrjagin (Prof. L.), translated by Emma Lehmer, Topological Groups (*Review*), 44
Poole (Dr. E. G. C.), [obituary article], 88
Poulton (Sir Edward), Animal Coloration and Natural Selection (*Review*), 144
Powell (Dr. C. F.), [Dr. W. Heitler, Dr. H. Heitler and], Absorption of Heavy Cosmic Ray Particles, 65 ; Dr. H. Heitler and Dr. F. C. Champion, Neutron-Proton Scattering at High Energies, 716
Powell (E. O.), Velocity of Hydration of Carbon Dioxide in the presence of Extraneous Substances, 401
Powell (H. M.), [Prof. N. V. Sidgwick and], Stereochemical Types and Valency Groups (Bakerian lecture), 70
Powell-Cotton (Major P. H. G.), [death], 18 ; [obituary articles], 223, 224
Prain (Sir David), and I. H. Burkill, An Account of the Genus Dioscorea in the East. Part 2 : The Species which Twine to the Right, with Addenda to Part 1, and a Summary (*Review*), 503
Preston (F. G.), Cambridge University Botanic Garden, 126
Price (J. R.), [H. N. Barber and], Nature of the Feulgen Reaction with Nucleic Acid, 335 ; [G. H. Beale, R. Scott-Moncrieff and], Biochemistry of Flower-pigments in Verbena, 690 ; and H. N. Barber, Nature of the Feulgen Reaction with Nucleic Acid, 808
Priestley (J. B.), The Postscripts of, 585
Priestley (Dr. R.), University Students and Compulsory Service, 162
Pruthi (Hem Singh), and M. S. Mani, Indian Parasitic Chalcidoidea, 235

Quastel (Dr. J. H.), Micro-Diffusion in Chemical Analysis (*Review*), 113

Radcliffe-Brown (A. R.), Joking Relationships, 305
Radley (J. A.), Starch and its Derivatives (*Review*), 823 ; and Dr. Julius Grant, Fluorescence Analysis in Ultra-Violet Light. Third edition (*Review*), 216
Rae (Prof. W. N.), [Dr. J. Reilly and], Physico-Chemical Methods. Third edition. 2 Vols. (*Review*), 5
Raman (Sir C. V.), and P. Nilakantan, Modified Reflection of X-Rays, 523 ; Classical and Quantum Reflections of X-Rays in Crystals, 686
Ramirez (J. E.), Origin of Microseisms, 271
Ramsey (A. S.), Hamilton's Dynamics (*Review*), 180
Rao (H. N. Ramachandra), Electric Tunnel Kilns for Firing Porcelain, 842
Rao (Dr. K. R.), and M. G. Sastry, Atomic Energy Values of Ionized Tellurium (Te II), 523
Rao (K. S.), and S. R. N. Rao, The Fossil Charophyta of the Deccan Inter-Trappeans near Rajahmundry, India, 101
Rashevsky (Dr. N.), Advances and Applications of Mathematical Biology (*Review*), 444
Rautenstrauch (Prof. W.), Industrial Surveys and Reports (*Review*), 419 ; The Economics of Business Enterprise (*Review*), 574
Rawlins (F. I. G.), The Measurement of Art, 292
Rawson (C.), [death], 123

Rayleigh (Lord), McLennan: a Pioneer of Canadian Science (*Review*), 111; Sir J. J. Thomson, 352
Raynal (Dr. J.), awarded the French Commission gold medal, 836
Raynor (G. V.), [W. Hume-Rothery, P. W. Reynolds and], Formation of 3/2 Electron Compounds in Alloys of Copper, Silver, and Gold, 528
Read (C. B.), Upper Palæozoic Floras of South America, 236
Read (Prof. J.), Alphabetical Chemistry (*Review*), 280
Reay (G. A.), Freezing and Cold Storage of Fish, 782
Reboul (J. A.), Photographic Action of Metals, 103
Redgrave (H. S.), Shortage of Lavender Oil, 304
Reed (Dr. H. D.), and Prof. B. P. Young, Laboratory Studies in Zoology. Second edition (*Review*), 546
Reeve (E. C. R.), Trends in Mathematical Biology (*Review*), 444
Reilly (Prof. J.), and Prof. W. N. Rae, Physico-Chemical Methods. Third edition. 2 Vols. (*Review*), 5; [T. MacCurtin and], Sclerotiorine, a Chlorinated Metabolic product of *Penicillium Sclerotiorum*, Van Beyma, 335
Renaud (E. B.), Stone Age Industries in Wyoming, U.S.A., 134
Reynolds (P. W.), [W. Hume-Rothery, G. V. Raynor and], Formation of 3/2 Electron Compounds in Alloys of Copper, Silver, and Gold, 528
Rhead (E. L.), [death], 584; [obituary article], 678
Rhodes (H. T. F.), Forensic Chemistry (*Review*), 414
Riceman (D. S.), C. M. Donald and S. T. Evans, Copper-deficient Australian Soils, 434
Richardson (Sir Owen), Sir J. J. Thomson, 355
Richardson (W. A.), and R. S. Higginbotham, Influence of Combined Phosphoric Acid on the Swelling of Granular Starch, 234
Richmond (I. A.), Roman Policy in Northern Britain, 463
Richter (C. F.), [B. Gutenberg and], Earthquakes of South and Central America, 270
Rideal (Prof. E. K.), O. Gatty, 17; Chemical Change (*Review*), 603; [D. D. Eley and], Parahydrogen Conversion on Tungsten, 401; [Dr. F. R. Eirich and], The Air-driven Ultracentrifuge, 541
Riesman (Prof. D.), [death], 123
Riley [D.], A Patterson Analysis derived from the Cyclol C_2 Skeleton, 231
Riley (N. D.), Dr. F. W. Edwards, 739
Ritchie (Prof. A. D.), Nature and Psyche (*Review*), 531
Ritchie (Prof. J.), Sherborn's Where is the — Collection? (*Review*), 80; Taxonomy in the Jungle, 240; Cell "Radiations" (*Review*), 538
Rivlin (R. S.), Grinding and Scratching Crystalline Surfaces, 806
Roberts (Dr. Austin), The Birds of South Africa (*Review*), 345
Roberts (E. A. Houghton), Nature of the Cyanide-stable portion of Cellular Respiration, 461
Roberts, jun. (Dr. F. H. H.), Archæological Remains in the Whitewater District, Eastern Arizona. Part 2: Artifacts and Burials, 659
Roberts (Dr. J. K.), The Theory of Adsorption on Square Lattices, 372
Robinson (B. H.), [T. M. Little, J. H. Kantor and], Genetics and Long-day Plants, 135
Robinson (Sir Robert), appointed a member of the advisory council to the committee of the Privy Council for Scientific and Industrial Research, 557
Robson (Dr. J. M.), Recent Advances in Sex and Reproductive Physiology. Second edition (*Review*), 502; and Dr. J. Adler, Site of Action of Œstrogens, 60
Robson (Dr. W. A.), Labour under Nazi Rule, 260
Rochester (Dr. G. D.), and M. Bound, Absorption of Cosmic Ray Protons in Lead, 745
Rodgers (T. L.), Note of the Anna Hummingbird, 305
von Rohr (Prof. L. O. M.), [obituary article], 515
Rolleston (Dr. J. D.), Prof. Giuseppe Sanarelli, 54; W. G. Spencer, 678; Prof. Julius Wagner-Jauregg, 832
Roosevelt (President), Ideals of Democracy, 124; re-elected President of the U.S.A., 614; The New Order, 679
Root (C. J.), Analysis of Winter Temperature, 809
Rose-Legrand (Dr. M. L.), Undulant Fever in Normandy, 399
Rosen (N.), [G. R. Harrison and], Spectrographic Analysis of Singly Ionized Praseodymium, 371
Rosenberg (Prof. H.), [death] 678; [obituary article] 770
Ross (Sir Denison), [obituary article], 423
Rosse (Earl of), centenary of the birth of; work of, 648
Rossi (Dr. B.), appointed associate professor of physics in Cornell University, 163
Rothschild (Hon. Miriam), [Miss Elizabeth Meyerhof and], A Prolific Trematode, 367
Roussy (Dr. G.), removed from the rectorship of Paris University, 715
Rowe (C. H.), Camouflage in War-time, 168; 462
Roxo (de Oliveira), Habitat of the Plant Remains found in the Coal-bearing Deposits of South Brazil, 237
Rubbo (Dr. S. D.), and J. M. Gillespie, Para-Amino Benzoic Acid as a Bacterial Growth Factor, 838
Ruhemann (Prof. M.), Science and the Soviet Citizen, 555
Russell (Sir Alexander), Public Health Progress in India, 297
Russell (Dr. A.), History of the Power Station Industry (*Review*), 146; Dr. C. H. Merz, 613
Russell (Dr. E. S.), F. M. Davis, 55; Animal Behaviour (*Review*), 317
Russell (Prof. H. N.), and Charlotte E. Moore, Masses of the Stars, 103
Russell (Sir John), C. H. Turnor, 359; Farming Without Soil, 448; Food Production in Great Britain and in Western Europe, 702; Applied Biology in War-time, 813
Rutherford (Dr. D. E.), Vector Methods: applied to Differential Geometry, Mechanics and Potential Theory (*Review*), 665
Rutledge (Prof. G.), [death], 678
Rutledge (R. H.), Range Conservation, 205
Ryder (Col. C. H. D.), Col. H. L. Crosthwait, 553
Ryves (P. M.), Investigation of the Period of R. W. Sagittarii, 170

Sachanen (Dr. A. N.), Conversion of Petroleum: Production of Motor Fuels by Thermal and Catalytic Processes (*Review*), 507
Sahni (B.), Recent Advances in Indian Palæobotany, 101
Salaman (Dr. R. N.), The Ormskirk Potato Research Station, 634
Salmond (Miss M. D.), [Dr. R. G. Cochrane, Dr. M. Paulraj and], Wheat Diet and Leprosy, 497
Salvemini (Prof. G.), Historian and Scientist: an Essay on the Nature of History and the Social Sciences (*Review*), 179
Sampson (Kathleen), and J. H. Western, Diseases of Pasture Grasses, 779
Samuel (Viscount), Science and Civilization (Messel lecture), 175
Samuely (F. J.), and C. W. Hamann, Building Design and Construction: with reference to the New L.C.C. Regulations. Vol. 1 (*Review*), 347
Sanarelli (Prof. Giuseppe), [obituary article], 54
Sand (Dr. H. J. S.), Electrochemistry and Electrochemical Analysis. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests (*Review*), 543
Sanders (Dr. H. G.), An Outline of British Crop Husbandry (*Review*), 79
Sanderson (Prof. Dwight), and Prof. R. A. Polson, Rural Community Organization (*Review*), 385
Sanderson (I. T.), Mammals of the North Cameroons Forest Area, 240
Sargant-Florence (M.), Colour Co-ordination (*Review*), 475
Sargent (J.), Progress of Education in India, 1932–1937, 365
Sastry (M. G.), [Dr. K. R. Rao and], Atomic Energy Values of Ionized Tellurium (Te II), 523
Saville (Sir Leopold), Early Harbour Engineering, 615
Savory (Prof. D. L.), elected member of Parliament for Queen's University, Belfast, 617
Sawyer (Dr. W. A.), Yellow Fever and its Control, 595

Scarisbrick (R.), (R. Hill and], Production of Oxygen by Illuminated Chloroplasts, 61

Schofield (M.), Robert Boyle, 488

Scholefield (Dr. G. H.), Some Problems of the New World Order (Cawthron lecture), 225

Schomaker (V.), and D. P. Stevenson, Structure of Sulphur Dioxide, 102

Schönland (Prof. S.), [obituary article], 395

Schrödinger (Prof. E.), appointed senior professor in the School of Theoretical Physics of the Dublin Institute for Advanced Studies, 679

Schwab (J. J.), Pleiotropic Effect of Genes, 102

Schwenning (Prof. G. T.), [Prof. E. H. Anderson and], The Science of Production Organization (*Review*), 574

Scoloudi (Miss Irene), Work of Sir Theodore Turquet de Mayerne, 773

Scott (Dr. H. Harold), Col. Kenneth Macleod, 201

Scott-Blair (Dr. G. W.), and F. M. V. Coppen, Compression of Cylinders of Soft Materials, 840

Scott-Moncrieff (R.), [G. H. Beale, J. R. Price and], Biochemistry of Flower Pigments in Verbena, 690

Sears (P. B.), Ecological Basis of Land Use and Management, 309

Secoy (C. H.) and G. H. Cady, Chlorine Monoxide and Water, 136

Seibert (H. C.), Maternal Constitution and Infant Mortality, 236

Sekido (Y.), [Dr. Y. Nishina, H. Simamura, Dr. H. Arakawa and], Cosmic Ray Intensities in relation to Cyclones and Anticyclones, 95

Seligman (Prof. C. G.), The Anuak (*Review*), 279 ; [obituary articles], 514–15

Selvey (W. H.), Scientific Training and Administration, 648

Selye (H.), [J. B. Collop, D. L. Thomson and], Antihormones, 463

Semmens (C. S.), Nature of the Feulgen Reaction with Nucleic Acid, 130 ; 808 ; [P. N. Bhaduri and], Advantages of Uranium Fixation in Modern Cytological Technique, 100

Sezawa (K.), Plasticity Conditions for Fault Formation, 136 ; and K. Kanai, Plasticity Conditions for the Formation of Faults, 307

Shannon [Kerr, Arnold and], Vibration of Propeller Blades, 843

Sharman (Dr. B. C.), A Periclinal Division in the 'Dermatogen' at the Tip of the Maize Growing Point, 778

Shaw (J. C. Middleton), New Fossil Primate from Sterkfontein, South Africa, 489

Shaw (Col. J. J. M.), [death], 453

Shaw (Sir Napier), Forecasting Weather. Third edition, with a supplementary note on Sixteen Years' Progress in Forecasting Weather, by R. G. K. Lempfert (*Review*), 818

Shebbeare (E. O.), elected president of the Malayan Nature Society, 771

Sheffield (F. M. L.), Inclusions in the Cells of Virus-Infected Plants, 68

Shen (Dr. Shih-Chang), [Dr. A. S. C. Lawrence, Dr. J. Needham and], Relations between Molecular and Morphological Shape of Protein Solutions, 104

Shepard (Prof. F. P.), Submarine Geology and Geophysics, 431

Sherborn (Dr. C. Davies), Where is the — Collection ? (*Review*), 80

Sherman (Prof. H. C.), awarded the Borden medal and prize for research in Nutrition, 365

Shewhart (Dr. W. A.), with the editorial assistance of Dr. W. E. Deming, Statistical Method from the Viewpoint of Quality Control (*Review*), 150

Shotter (G. F.), [E. Fawssett, H. W. Grimmitt, Dr. H. G. Taylor and], Practical Aspects of Earthing, 623

Shrader (Dr. J. H.), Food Control, its Public-Health Aspects (*Review*), 385

Shukoff (R. I.), (P. R. Peacock and], Use of Desiccated Chick Embryo in Tissue Culture Technique, 30

Shute (P. G.), [Lt.-Col. J. A. Sinton and], Control of Mosquito Nuisances in Great Britain, 683

Sidgwick (Prof. N. V.) and H. M. Powell, Stereochemical Types and Valency Groups (Bakerian lecture), 70

Siegbahn (Prof. K. M. G.), awarded the Rumford medal of the Royal Society, 679 ; work of, 750

Sieglinger (J. B.), Achimæra in Sorghum, 656

Sigurdsson (P.), The University of Iceland, 762

Sikka (S. M.), Cyto-Genetics of Brassica, 524

Simamura (H.), [Dr. Y. Nishina, Y. Sekido, Dr. H. Arakawa and], Cosmic Ray Intensities in relation to Cyclones and Anticyclones, 95

Simha (Dr. R.), [Dr. H. Mark and], Viscosity and Molecular Structure, 167

Simmons (Lt.-Col. J. S.), Epidemiology in the Army, 228

Simpson (G. G.), Early Mammals of South America, 270

Sinclair (Col. T. S.), [death], 740

Sinnott (E. W.), and R. Black, Cell-Division, 68

Sinton (Lt.-Col. J. A.), and P. G. Shute, Control of Mosquito Nuisances in Great Britain, 683

Sitgreaves (Rosedith), [W. M. Gafafer and], Cancer in an Oil Refinery, 617

Sitholey (R. V.), Jurassic Plants from Afghan Turkestan, 101

Slater (late Dr. C.), bequests by, 23

Sleggs (G. F.), Theory of Differential Periodicity, 495 ; Differential Periodic Theory of Growth, 621

Smart (Dr. J.), [Dr. F. W. Edwards, H. Oldroyd and], British Blood-Sucking Flies (*Review*), 447

Smart (Dr. W. M.), The K Term and the Galactic Rotational Constant, 103 ; appointed Halley lecturer at Oxford for 1941, 805

Smith (Dr. A. C.), appointed curator of the herbarium of the Arnold Arboretum of Harvard University, 775

Smith (Dr. A. M.), [H. H. Corner and], Cobalt and Pine Disease, 168

Smith (C.), Britain's Food Supplies in Peace and War : a Survey prepared for the Fabian Society (*Review*), 632

Smith (F.), [Prof. W. N. Haworth, J. Jackson and], Properties of 3 : 6-Anhydrogalactose, 35 ; [Miss S. Luckett and], Constitution of Pectic Acid, 525

Smith (H.), [Dr. K. Lonsdale, Dr. I. E. Knaggs and], Diffuse Reflection of X-Rays by Single Crystals, 332

Smith (Prof. J. L. B.), A Living Coelacanthid Fish from South Africa, 53

Smith (Dr. Kenneth M.), The Virus : Life's Enemy (*Review*), 602

Smith (Miss Marian W.), The Puyallup-Nasqually (*Review*), 349

Smith (Dr. May), Health and Occupation (*Review*), 6

Smith (Prof. P. E.), Gonadotropic Hormones, 624

Smith (Sidney), Antiquities from the Northumberland Collections, 296 ; Archæological Journeys in Western Persia (*Review*), 537

Smith (S.), [W. D. Lang, H. D. Thomas and], Index of Palæozoic Coral Genera, 195

Smith (S. G.), [C. J. Cadwallader, F. O. Hewitt and], Reversibility of the Denaturation of Silk Fibroin, 301

Smith (Dr. S. L.), [Dr. W. A. Wood and], A Lattice Stress-Strain Diagram, 400

Smith (T. J.), [L. D. Leet and], Determination of the Depth of Glacial Deposit, 810

Smith (Sir William Wright), The Taxonomy of Tulipa (*Review*), 379

Smuts (General), Man's Passion for Freedom, 124

Smyth (C. P.), G. L. Lewis, A. J. Grossman and F. B. Jennings, Dipole Moments and Structures, 136

Smythe (Prof. W. R.), Static and Dynamic Electricity (*Review*), 446

Snell (Dr. Cornelia T.), [Dr. Foster Dee Snell and], Chemicals of Commerce (*Review*), 543

Snell (Dr. Foster Dee), and Dr. Cornelia T. Snell, Chemicals of Commerce (*Review*), 543

Snell (Dr. H. K.), War, Drunkenness and Suicide, 90

Snyder (Miss Emily Eveleth), Biology in the Making (*Review*), 443

Snyder (J. O.), Californian Trout, 494

Soddy (Prof. F.), Sir J. J. Thomson, 353

Solander (Daniel), work of, 295

Speck (Prof. F. G.), Penobscot Man: the Life-History of a Forest Tribe in Maine (*Review*), 386
Speiser (Prof. E. A.), Ancient Mesopotamia and the Beginnings of Science, 705
Spencer (W. G.), [obituary article], 678
Spitz (A. N.), The Pinpoint Planetarium (*Review*), 350
Spooner (Prof. H. J.), [death], 833
Spring (Dr. F. S.), and G. Swain, Formation of Insoluble Digitonides of Cholesterol Derivatives, 718
Staley (J.), A Species of Mosquito (Diptera, Culicidæ) new to Britain, 368
Stapledon (Sir George), Re-grassing, 56
Stebbing (Prof. E. P.), American Applied Sylviculture (*Review*), 701
Stebbins (G. L.), and E. B. Babcock; and J. A. Jenkins, Apomixis in Crepis, 34
Stebbins, Huffer and Whitford, Absorption of Light by Interstellar Matter, 810
Steensberg (A.), A Rural Industry of Jutland, 67
Stein (Sir Aurel), Old Routes of Western Irān. Antiquities Examined, Described and Illustrated with the assistance of F. H. Andrews (*Review*), 537
Stein (Dr. L.), and Prof. E. Wertheimer, Cardiac Metabolism and Rigor in Thyroidectomized Rats, 521
Stein (L.), Abnormalities of Speech and the Development of Language, 33
Stekel (Dr. Wilhelm), [obituary article], 123
Stenton (F. M.), [J. E. B. Gover, A. Mawer and], The Place-Names of Nottinghamshire (*Review*), 820
Stern (Major F. C.), elected honorary treasurer of the Linnean Society, 650
Stetson (H. T.), and others, Fundamental Aspects of Radio Communication, 450
Stevenson (D. P.), [V. Schomaker and], Structure of Sulphur Dioxide, 102
Stewart (Dr. C. A.), Advanced Calculus (*Review*), 730
Stewart (Dr. D. W.), and Dr. K. Cohen, Isolation of a Heavy Sulphur, 555
Stewart (G. E.), Pueblo Indian Irrigation Systems, 591
Stewart (G. W.), A New Conduction of Heat Phenomenon, 562
Stewart (J. A.), Iron Age Cypriot Jugs, 689
Stewart (Dr. T. D.), Skeletal Remains from the Whitewater District, Eastern Arizona, 659
Stino (K. R.) Variegation in *Nicotiana Tabacum*, 170
Stockdale (Sir Frank), appointed comptroller for Development and Welfare in the West Indies; work of, 425
Stocks (Dr. P.), Morbidity and Death-Rates in Great Britain, 648
Stoddart (E. M.), Reaction between Chlorine and Nitric Oxide, 592
Stodola (Prof. A.), awarded the James Watt international medal, 554
Stoneley (R.), Interior of the Earth, 203
Stonor (C. R.), Courtship and Display among Birds (*Review*), 794
Stott (E. W.), [W. H. Kerry and], Freehand Drawing and Pictorial Illustration for Draughtsmen, 457
Stout (P. R.), [Prof. D. R. Hoagland, T. C. Broyer and], Upward Movement of Salt in the Plant, 340
Strain (W. B.), Screened Dust and its Uses, 610
Stratton (Prof. F. J. M.), The Total Solar Eclipse of October 1, 1940, 422
Straub, Crystalline Lactic Dehydrogenase, 69
Strömberg (G.), The Soul of the Universe (*Review*), 543
Strong (Prof. J.), and others, Modern Physical Laboratory Practice (*Review*), 386
Stroud (Prof. H.), [obituary article], 552
Stroud (S. W.), Evidence of Demethylation in the Animal Body, 166
Stuart (J. Gray), appointed a member of the Medical Research Council, 365
Stull (Olive Griffith), Variation in the Bull or Gopher-Snakes (*Pituophis*), 524
Sukov (Dr. M.), The Long-term Prisoner, 229
Sutton (E.), [M. Demerec and], Unequal Breaks in Sister Chromatids, 592
Svensson (R.), A Handbook of Malaria Control (*Review*), 823
Sveschnikova (I. N.), Heterosis, 719
Swain (G.), [Dr. F. S. Spring and], Formation of Insoluble Digitonides of Cholesterol Derivatives, 718
Synge (R. L. M.), [A. J. P. Martin and], Volatile Aldehydes Liberated by Periodic Acid from Protein Hydrolysates, 491

Taylor (A.), and D. Laidler, Anomalous Diffractions in the Hull-Debye-Scherrer Spectrum of Graphite, 130
Taylor (Prof. E. H.), 'Island' Faunas on the Mexican Plateau, 467
Taylor (Dr. F. Sherwood), Science Front, 1939 (*Review*), 45
Taylor (Prof. G. I.), elected president of the British Rheologists' Club, 518
Taylor (Dr. H. G.), [E. Fawssett, H. W. Grimmitt, G. F. Shotter and], Practical Aspects of Earthing, 623
Taylor (Prof. H. J.), D. Fraser and V. D. Dabholkar, The Possibility of Detecting a Doubly-charged Proton by the Photographic Method, 777
Taylor (Prof. H. S.), Kinetics of Contact Catalysts and the Industrial Background, 768
Taylor (Dr. Lockwood), Directional Stability of Ships, 563
Tempany (Dr. H. A.), appointed agricultural adviser to the Colonial Secretary, 426
Temple (Prof. G.), Electromagnetic Theory (*Review*), 446
Templeman (W. G.), Nutrient Solution Culture of Plants (*Review*), 633
Teng (S. C.), A Fungicidal Fertilizer, 102
Test (F. H.), Changes in the Colours of Birds, 269
Thackeray (A. D.), Convective Equilibrium and Solar Limb Darkening, 749
Thomas (Sir Daniel), [death], 224
Thomas (H. D.), [W. D. Lang, S. Smith and], Index of Palæozoic Coral Genera, 195
Thomas (Meirion), Plant Physiology. Second edition (*Review*), 823
Thomas (P. T.), Origin of the Loganberry, 202; Reproduction in Rubus, 337
Thompson (Sir D'Arcy W.), Science and the Classics (*Review*), 76
Thompson (Prof. F. C.), E. L. Rhead, 678
Thompson (H. V.), [late Dr. J. W. Mellor and], A Treatise on Quantitative Inorganic Analysis: with special reference to the Analysis of Clays, Silicates and Related Minerals. Second edition (*Review*), 385
Thompson (Mrs. Lilian Gilchrist), Sidney Gilchrist Thomas: an Invention and its Consequences (*Review*), 245
Thomson (Sir J. J.), [death], 329; [obituary articles], 351 to 357
Thornley (S. K.), Camouflage in War-time, 462
Thornton (D. L.), Earthquakes and Structures, 437
Thornton (Prof. W. M.), Electrical and Mechanical Transmission of Energy (Andrew Laing lecture), 693
Thorpe (Dr. W. V.), and Dr. R. T. Williams, Isolation of Acetylsulphathiazole from Human and Rabbit Urines following Administration of M and B 760, 686
Ticehurst (N. F.), [H. F. Witherby, late Rev. F. C. R. Jourdain, B. W. Tucker and], The Handbook of British Birds. Vol. 4: Cormorants to Crane (*Review*), 411
Tillotson (E.), The Rumanian Earthquake of November 10, 675
Titus [Baxter and], Atomic Weight of Iodine, 405
Todd (Prof. A. R.), Chemistry of the Hemp Drugs, 829
Todd (Prof. G. W.), Prof. H. Stroud, 552
Todd (Dr. J. A.), Text-Books of Advanced Mathematics (*Review*), 665
Todd (Prof. R. A.), [J. Madinaveitia, A. L. Bacharach, M. R. A. Chance and], Mucolytic Activity of Diffusing Factor Preparations, 197
Todd (Dr. Tweedie John), centenary of the death of; work of, 162
Toghill (E. C.), and R. V. Dowle, Applications of Cast Iron in Modern Automobile Construction, 208
du Toit (Dr. A. L.), The Geology of South Africa. Second edition (*Review*), 214

Tolansky (Dr. S.), and S. A. Trivedi, Hyperfine Structure in the Arc Spectrum of Bromine, 687
Tomkeieff (S. I.), First Use of Current-Bedding to Determine Orientation of Strata, 369
Tomlin (E. W. F.), Turkey : the Modern Miracle, 89
Tompsett (Dr. D. H.), Sepia (*Review*), 350
Toms (B. A.), Binding of Water by Stearanilide, 266 ; Hydration of Substituted Amides of Stearic Acid, 560
Tory (Dr. H. M.), Organization and Work of the Royal Society of Canada, 171
Tremain (W. E.), Significance of Television, 21
Trivedi (S. A.), [Dr. S. Tolansky and], Hyperfine Structure in the Arc Spectrum of Bromine, 687
Truscott (Prof. S. J.), Prof. William Frecheville, 223
Tucker (B. W.), [H. F. Witherby, the late Rev. F. C. R. Jourdain, N. F. Ticehurst and], The Handbook of British Birds. Vol. 4 : Cormorants to Crane (*Review*), 411
Turnbull (Prof. H. W.), Theory of Equations (*Review*), 665
Turner (Miss E. L.), [death], 395 ; [obituary article], 424
Turner (Prof. J. S.), and others, Biology in Australian Schools, 363
Turnor (C. H.), [obituary article], 359
Turquet de Mayerne (Sir Theodore), Work of, 773
Tyler (Dr. W. M.), Flight and Habits of the Humming-bird, 466
Tyndall (Mrs.), [death], 257 ; [obituary article], 294
Tyson (G. N.), and S. C. Adams, Configurations of Quadricovalent Complexes, 103

Uhlig (H. H.), and J. Wulff, Corrosion Resistant Alloys, 562
Unwin (Sir Raymond), [death], 18
Urey (Prof. H. C.), Chemical Separation of Isotopes, 434 ; awarded the Davy medal of the Royal Society, 679 ; work of, 751
Uspensky (Prof. J. V.), and Prof. M. A. Heaslet, Elementary Number Theory (*Review*), 418

Valder (H.), endowment of a research fellowship in social relations in industry, at Victoria University College, Wellington, New Zealand, 519
Vallance (R. H.), [Dr. J. Newton Friend, H. J. G. Challis and], Phosphate Separation in Qualitative Analysis, 63
Van Duzee (E. P.), [death], 453
Vazquez-Lopez (Dr. E.), Golgi Apparatus as an Indicator of Secretory Activity in Pancreatic Islet Cells, 589
Vernon (Dr. H. M.), Health in relation to Occupation (*Review*), 6 ; The Health and Efficiency of Munition Workers (*Review*), 599
Vernon (Dr. P. E.), The Measurement of Abilities (*Review*), 46
Vigors (Nicholas Aylmer), centenary of the death of ; work of, 554
Vincent (Prof. H.), elected vice-president of the Paris Academy of Sciences, 263
Virchow (Prof. Hans), [death], 190
Volterra (Prof. V.), [death], 516

de Waal (Dr. H. L.), South African Senecio Alkaloids, 777
Wace (A. B.), Mycenean Origins and Chronology, 454
Waddicor (H.), The Principles of Electric Power Transmission by Alternating Currents. Fourth edition (*Review*), 668
Waddington (Dr. C. H.), Somatic Mutations of the Straw Locus in Drosophila, 335 ; Organizers and Genes (*Review*), 413 ; Development of Wings in Drosophila, 689 ; Anatomical Embryology (*Review*), 728
Wade (A. E.), [H. A. Hyde and], Welsh Ferns : a Descriptive Handbook, 743
Wagner-Jauregg (Prof. Julius), [obituary article], 832
Wahba (Dr. M.), [Dr. N. Fakhoury and], Swelling of Wood Charcoal : Experiments with a new Silica Extensometer, 63
Walker (Miss Hilda), Prof. E. W. W. Carlier, 452
Walker (Prof. J. C.), Diseases of Vegetable Crops. New edition (*Review*), 758
Wall (F. T.), Ionic Character and Dipole Moment, 271
Wallace (Hon. H. A.), Co-operative Agricultural Research in the Americas, 151
Wallace (Principal R. C.), elected president of the Royal Society of Canada, 172
Wallace (T.), Magnesium Deficiency of Fruit Trees, 337
Walter (E. J.), Earthquake Travel-times and Structure South of St. Louis, 809
Walton (Prof. J.), An Introduction to the Study of Fossil Plants (*Review*), 249
Warburg (E. F.), Evans's A Flora of Cambridgeshire (*Review*), 250
Warburton (W. H.), awarded a Leverhulme research fellowship, 93
Ward (F. Kingdon), Garden Plants of the Future, 34
Wardlaw (Prof. C. W.), Physiology of Storage in Bananas, 525
Warren (A. G.), Mathematics applied to Electrical Engineering (*Review*), 77
Warren (F. L.), Relative Kidney Weights of Male and Female Mice, 367
Watkins (A. E.), and S. Ellerton, Genetics of Awns in Triticum, 135
Watson (Prof. D. M. S.), Origin of Frogs, 404
Watson (Dr. W. W.), appointed professor of physics in Yale University, 128
Waugh (Peggy), [Prof. J. Stanley Gardiner and], Corals of the John Murray Expedition, 169
Webb (D. A.), and Dr. J. F. Danielli, Concentration of Cations at Negatively Charged Surfaces, 197
Weber (Prof. H. C.), Thermodynamics : for Chemical Engineers (*Review*), 631
Weigert (Prof. F.), Vision and the Photochemistry of Visual Purple, 31
Weiner (J. S.), Ventilation of Air Raid Shelters, 733
Weiser (Prof. H. B.), Colloid Chemistry (a Textbook) (*Review*), 544 ; and W. O. Milligan, Precipitation of Colloids by Electrolytes, 622
Weizmann (Prof. C.), Prof. V. Henri and Dr. E. Bergmann, Identification and Determination of Aromatic Compounds in Mineral Oils, 230
Wells (H. G.), Babes in the Darkling Wood (*Review*), 822
Wertheimer (Prof. E.), [Dr. L. Stein and], Cardiac Metabolism and Rigor in Thyroidectomized Rats, 521
Western (J. H.), [Kathleen Sampson and], Diseases of Pasture Grasses, 779
Westland (C. J.), A Non-Historical Eclipse, 718
Westoll (T. S.), [F. R. Parrington and], Evolution of the Mammalian Palate, 655
Westveld (Prof. R. H.), Applied Sylviculture in the United States (*Review*), 701
Wetmore (A.), Check-List of the Fossil Birds of North America, 561
Weyl (Prof. H.), The Classical Groups : their Invariants and Representations (*Review*), 44
Wheat (J. A.), and A. W. Browne, Perchlorides of Hydrogen, 434
Wheeler (Prof. Alvin S.), [death], 55
Wheeler (Dr. J. F. G.), A Parachute Fishing Net, 683
Wheeler (late Prof. R. V.), [R. Belcher and], Composition of Coal, 525 ; [Dr. R. A. Mott and], The Quality of Coke : being the second report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council (*Review*), 573
Wheeler (W. F.), Intermediate Biology (*Review*), 570
White (E. C.), Bactericidal Action of Mould Products, 404
White (M. J. D.), Translocation in Wild Grasshoppers, 68 ; Evidence for Polyploidy in the Hermaphrodite Groups of Animals, 132
White (T.), Linkage in the Human Sex Chromosome, 561
Whitehead (J. H. C.), Group Theory (*Review*), 44
Whitehead (S.), [A. E. W. Austen and], Electric Strength of some Solid Dielectrics, 595
Whitford [Stebbins, Huffer and], Absorption of Light by Interstellar Matter, 810
Whiting [Boswell and], Respiration in the Higher Plant, 783

Whittaker (Prof. E. T.), elected president of the Royal Society of Edinburgh, 617
Whittlesey (Prof. C. R.), Relation of Totalitarianism to International Trade and Finance, 241
Whysall (F. H.), Rising Cost of Generating Electricity, 92
Whyte (A. Gowans), Make Your Own Religion, 486
Wicks (Dr. C. A.), Tuberculosis in Mental Hospitals, 456
Wiggers (Prof. C. J.), Physiology in Health and Disease. Third edition (*Review*), 80
Wildt (Dr. R.), Atmosphere of Venus, 810
Wilkins (Prof. T. R.), Excited States of Stable Nuclei, 401
Wilkinson (Dr. J. F.), Anti-Pernicious Anæmia Principle in Urine, 169; and P. de Fremery, Gonadotropic Hormones in the Urine of the Giraffe, 491
Williams (A. E.), Synthetic Rubber, 487
Williams (C. H.), A New Cardiac Glycoside ?, 303
Williams (F. E.), Drama of Orokolo: the Social and Ceremonial Life of the Elema (*Review*), 380
Williams (Dr. R. T.), [Dr. W. V. Thorpe and], Isolation of Acetylsulphathiazole from Human and Rabbit Urines following administration of M. and B. 760, 686
Wilsmore (Prof. N. T. M.), [death], 224; [obituary article], 360
Wilson (Prof. E. B.), Social Progress, 743
Wilson (Dr. M.), Rust Fungi attacking the Thistle, 779; M. Noble and E. G. Gray, Blind Seed Disease of Rye-Grass, 492
Wilson (R. M.), [obituary article], 453
Wilson (W. King), Fertility in Flemish and Smaller Types of Rabbit, 721
Winterbotham (Brig. H. St. J. L.), Dr. W. Bowie, 645
Winters (Prof. L. M.), Animal Breeding. Third edition (*Review*), 667
Witherby (H. F.), late Rev. F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker, The Handbook of British Birds. Vol. 4: Cormorants to Crane (*Review*), 411
Wolfe [Arrowsmith and], Use of Refrigeration to Delay Age-Hardening, 495
Wood (L. J.), [H. L. Link and], Reactions between Dry Salts, 237
Wood (Dr. W. A.), and Dr. S. L. Smith, A Lattice Stress-Strain Diagram, 400
Woodward (Sir Arthur Smith), The Surviving Crossopterygian Fish, Latimeria, 53; The Existing Coelacanth Fish, Latimeria, 590
Woody (Prof. T.), Principles of Totalitarian Education, 241
Wooster (Dr. W. A.), Books and Periodicals for Interned Scientific Men, 100
Wootton (Mrs. Barbara), Science and Pseudo-Science in Politics (*Review*), 508
Worcester (Prof. P. G.), A Textbook of Geomorphology (*Review*), 445
Wordie (J. M.), Lieut. J. H. Martin, 553
Wormald (Dr. H.), Brown Rot Fungi of Fruit Trees, 370
Wright (Sir Herbert), [death], 613; [obituary article], 677
Wright (Dr. N. C.), The Supply of Animal Feeding-Stuffs, 251; Britain's Supplies of Feeding-stuffs, 362, 712
Wright (Dr. W. D.), Colour Vision and Chromaticity Scales, 155; elected chairman of the Physical Society Colour Group, 427; Colour and Music (*Review*), 475; Colour Vision and Chromaticity Scales, 718
Wulff (J.), [H. H. Uhlig and], Corrosion Resistant Alloys, 562
Wyatt (T. W.), and D. Caradog Jones, Post-War Poverty and Unemployment can be Prevented (*Review*), 312

Yamaguchi (Prof. S.), Study of Amorphous Films by Electron Diffraction, 333
Yamaguchi (S.), An Electron Diffraction Study of the Surface of Magnesium attacked by an Aqueous Chloride Solution, 654
Yarnold (K. W.), and H. D. N. Fitzpatrick, Radiation and 'Stuffiness', 62
Yasaki (T.), [Dr. Y. Nishina, H. Ezos, Prof. K. Kimura, M. Ikawa and], Fission Products of Uranium produced by Fast Neutrons, 24
Yonge (Prof. C. M.), Biology of Reef-building Corals, 433; [A. J. Lloyd and], Correlation between Egg-carrying Setæ and Cement Glands in Decapod Crustacea, 334
Youmans (J. B.), Nutritional Œdema and Dietary Deficiency, 202
Young (Rev. Canon A.), [death], 833
Young (Prof. B. P.), [Dr. H. D. Reed and], Laboratory Studies in Zoology. Second edition (*Review*), 546
Young (Dr. F. G.), [H. P. Marks and], Species Variation in the Insulin Content of Pancreas, 31; [M. Griffiths and], Does the Hypophysis Secrete a Pancreotropic Hormone ?, 266
Young (Prof. R. K.), Dr. W. E. Harper, 452
Young (Dr. T. F.), [Prof. W. D. Harkins, E. Boyd and], Energy and Entropy of Extension and Spreading of Mobile Monolayers, 406
Younghusband (Sir Francis), Vital Religion: a Brotherhood of Faith (*Review*), 543

Zeller (Prof. R.), [death], 833
Zeuner (Dr. F. E.), Fossil Orthoptera Ensifera. Text and Plates (*Review*), 150
Zinsser (Prof. Hans), [obituary article], 516; As I Remember Him: the Biography of R. S. (*Review*), 761
Zondek (Prof. S. G.), [Dr. G. Brückmann and], 'Congenital' Copper Deposit in the Rat, 30
Zworykin (Dr. V. K.), [Dr. L. Marton and], A New Electron Microscope, 35

TITLE INDEX

Abattoir Wastes, Treatment of, J. H. Codling, 9
Aberdeenshire Dee, Estuary of the, Ecology of the, A. Milne, 135
Abilities, The Measurement of, Dr. P. E. Vernon (*Review*), 46
Accidents in Factories, Causes of, 259
Accretion and Stellar Energy, R. d'E. Atkinson, 271
Acetylsulphathiazole, Isolation of, from Human and Rabbit Urines following administration of M. and B. 760, Dr. W. V. Thorpe and Dr. R. T. Williams, 686
Actinium C″ from Lead, Production of, Dr. C. Bretscher and L. G. Cook, 430
Actinomycetes, Taxonomy of the, Prof. E. Baldacci, 170
Adaptive Coloration in Animals, Dr. H. B. Cott (*Review*), 144
Administration: Scientific Method in, 40; Co-ordination in, 341
Adsorption: at a Liquid Interface, C. W. Gibby and C. Argument, 203; The Theory of, on Square Lattices, Dr. J. K. Roberts, 372
Aerial Ropeway in Central Sweden, 650
Africa, Forms of Society and European Rule in, 188
African: Political Systems, edited by Dr. M. Fortes and Dr. E. E. Evans-Pritchard (*Review*), 189; Studies and the War, 192
Age-hardening, Use of Refrigeration to Delay, Arrowsmith and Wolfe, 495
Aggregates in Suspensions, Growth of, W. F. Carey, 232
Agricultural: Economists, Fifth International Conference of, held at Macdonald College, Canada, 21 August to 28 August, 1938, Proceedings of the (*Review*), 147; Research: Co-operative, in the Americas, Hon. H. A. Wallace, 151; Council, new members of the, 331; Industries, The, Prof. D. W. Malott and B. F. Martin (*Review*), 504
Agriculture: Library Catalogue of Printed Books and Pamphlets on, published between 1471 and 1840, Miss Aslin. Second edition, 92; Scholarships in, Awards of, 263; British, in War-time, 725
Air: -Jet Generator, The Acoustic, Prof. Hartmann, 623; Photography applied to Surveying, Dr. C. A. Hart (*Review*), 572; Raid Shelters: Private, Heating, D. Bellamy, 517; Conditions in, 712; Ventilation of, J. S. Weiner, 733; Raids: What You Must Know: What You Must Do, 125; Survey (*Review*), 572; Raid Damage, 802; 836
Alaska: Disease Among Natives of, Dr. J. D. Aronson, 298; to the Argentine, Highway from, 427
Albanian Fauna, The, 681
Aldehydes, Volatile, liberated by Periodic Acid from Protein Hydrolysates, A. J. P. Martin and R. L. M. Synge, 491
Aleutian Islands Earthquake, 592
Algebra, Advanced, S. Barnard and J. M. Child (*Review*), 665
Aliens: in National Work, Utilization of, 125; Welfare of, 192
Aliphatic Carbon Links, Energy of, E. C. Baughan and Prof. M. Polanyi, 685
All-Electric Laundry, An, 586
Alloys: Corrosion Resistant, H. H. Uhlig and J. Wulff, 562; Application of X-Rays to the study of, Dr. H. Lipson, 798
Alpha, Toxicity of, and Fast Neutron Radiation, R. D. Evans, 621
America: Southern South, Early Explorers of, from the United States, Col. L. Martin, 238; War-time, Recent Impressions of, Dr. J. Needham, 737
American: Conservation Schemes, Some Aspects of, 204; Museum of Natural History, Expeditions of the, 683
Americas, Cultural Unity in the, 673
Amerindian: Religious Reactions to Cultural Impact, Cora Du Bois, 169; Crania, Dr. A. Hrdlička, 336; Relics, 488
Ammonia: in Larvæ of *Lucilia cuprina*, Distribution of, F. G. Lennox, 268; Air-Raid Precautions to be taken by Users of, 518
Amorphous Films, Study of, by Electron Diffraction, Prof. S. Yamaguchi, 333
Ancestral Longevity and the Sex Ratio, P. S. Lawrence, 655
3:6-Anhydrogalactose, Properties of, Prof. W. N. Haworth, J. Jackson and F. Smith, 35
Animal: Coloration and Natural Selection, Sir Edward Poulton (*Review*), 144; Behaviour: Impulse, Intelligence, Instinct, late Dr. J. A. Loeser (*Review*), 317; Dr. E. S. Russell (*Review*), 317; Feeding Stuffs, Wild Seeds as, Dr. R. Melville, 403; Husbandry in India, 457; Biology, Principles of, Prof. L. Hogben. Second edition (*Review*), 545; Breeding: Prof. L. M. Winters. Third edition (*Review*), 667; The Science of, Dr. H. P. Donald (*Review*), 667
Animals, Drinking Habits of, A. Brownlee, 522
Antarctic: Two Men in the, an Expedition to Graham Land, 1920–1922, T. W. Bagshawe (*Review*), 282
Antarctica, Map of, E. P. Bayliss, 22
Anthropoids, Blood Groups of, Prof. J. B. S. Haldane, 652
Anthropology and Administration (*Review*), 380
Antibodies, Structure and Formation of, L. Pauling, 464
Antihormones, J. B. Collip, H. Selye and D. L. Thomson, 463
Anti-pernicious Anæmia Principle in Urine, J. F. Wilkinson, 169
Antiseptics in War-time Surgery, Prof. A. Fleming, 680
Anuak of the Anglo-Egyptian Sudan, The Political System of the, Dr. E. E. Evans-Pritchard (*Review*), 279; Prof. C. G. Seligman (*Review*), 279
Apple, Core Disease in the, H. P. Bell, 34
Aquatic Plants, A Manual of, Prof. N. C. Fassett (*Review*), 700
Arc, The, as a Standard of Light, Prof. J. T. MacGregor-Morris, 555
Archæological Remains in the Whitewater District, Eastern Arizona. Part 2: Artifacts and Burials, Dr. F. H. H. Roberts, jun., with an Appendix: Skeletal Remains from the Whitewater District, Eastern Arizona, Dr. T. D. Stewart, 659
Archæology: Fruits of the Renaissance in, Prof. Daryll Forde (*Review*), 213; During and After the War, A. W. Clapham, 426; and Tradition, 455; in the Eastern Mediterranean (*Review*), 505
Arctic and Antarctic (*Review*), 282
Argon, Liquid, Structure of, Prof. K. Lark-Horovitz and E. P. Miller, 459
Armant: Temples of, a Preliminary Survey, late Sir Robert Mond and O. H. Myers; with chapters by Miss M. S. Drower, D. B. Harden, S. A. Huzayyin, R. E. McEuen and Mary I. C. Myers. Text and Plates (*Review*), 664
Army Medical Services in War, Organization, Strategy and Tactics of the, Lt.-Col. T. B. Nicholls. With chapters by Air-Commodore A. S. Glynn, Col. A. R. Laurie and Col. F. G. Lescher. Second edition (*Review*), 314
Arnold Arboretum, Harvard University, Herbarium of the, Dr. A. C. Smith appointed curator of the, 775
Aromatic Compounds in Mineral Oils, Identification and Determination of, Prof. C. Weizmann, Prof. V. Henri and Dr. E. Bergmann, 230
A.R.P. Warden's Warning System, 427
Art, The Measurement of, F. I. G. Rawlins, 292

Arylamines, Restricted Rotation in, R. Adams and L. J. Dankert, 690
As I Remember Him: the Biography of R. S., late Prof. H. Zinsser (*Review*), 761
Atoms in Action: the World of Creative Physics, Prof. G. R. Harrison (*Review*), 760
Attraction Fields *in vitro*, Prof. J. C. Fardon, Rev. G. Brotzge, Sister M. Kenneth Loeffler and Juanita Breit, 619
Australasian Antarctic Expedition, Meteorology of the, 228
Australia: Commonwealth of, Scientific and Industrial Research, Thirteenth Annual Report, 308; Graptolites of, R. A. Keble and Prof. W. N. Benson, 561
Australian: Aborigines, Intelligence of, Dr. Fowler, 195; Soils, Copper-deficient, D. S. Riceman, C. M. Donald and S. T. Evans, 434; Timbers, Shrinkage of, W. L. Greenhill, 557
Australia's Electrical Requirements, 330
Automobile: Construction, Cast Irons in, E. C. Toghill and R. V. Dowle, 208; Research, 691
Awns in Triticum, Genetics of, A. E. Watkins and S. Ellerton, 135
Aztec Herbal, An, Dr. Agnes Arber, 81

Babes in the Darkling Wood, H. G. Wells (*Review*), 822
Banana, Ripening of the, H. R. Barnell, 494
Bananas, Physiology of Storage in, C. W. Wardlaw, 525
Barnacles attached to Birds, G. Ashcroft, 561
Barnard Free Skin and Cancer Hospital in St. Louis, Dr. W. Cramer appointed to the staff of the, 300
Be^{10}, Radioactivity of, Dr. E. Bretscher, 94
Bees, American Foul Brood in, Precautions against, 101; a correction, 163
Beetles Injurious to Timber and Furniture, Dr. R. C. Fisher, 773
Beilby Memorial Fund, Award from the, made to Dr. F. M. Lea, 771
Beit Memorial Fellowships for Medical Research, appointments and elections, 163
Belfast, Queen's University, Prof. D. L. Savory elected M.P. for, 617
Bell Telephone Laboratories, Inc., resignation by Dr. F. B. Jewett of the presidency, and election as chairman of the board of directors of the; Dr. O. E. Buckley appointed president, 834
Benin, Pre-Portuguese Bronze Castings from, Eva L. R. Meyerowitz, 463
Bessemer, Henry, and Sidney Gilchrist Thomas, Sir Harold Carpenter (*Review*), 245
Bibliographical and Intelligence Services, 298
Bibliography, World (*Review*), 630
Biochemistry: Annual Review of. Vol. 9 (*Review*), 383; Progress in, Dr. E. F. Armstrong (*Review*), 383; Carbohydrate, Introduction to, Dr. D. J. Bell (*Review*), 545
Biological Assay, International Standards for, 748
Biology: in Australian Schools, Prof. J. S. Turner and others, 363; Economic, Teaching of, 376; A History of (*Review*), 443; in the Making, Miss Emily Eveleth Snyder (*Review*), 443; Mathematical: V. A. Kostitzin, translated by T. H. Savory (*Review*), 444; Advances and Applications of, Dr. N. Rashevsky (*Review*), 444; Trends in, E. C. R. Reeve (*Review*), 444; Elementary, T. H. Hawkins (*Review*), 570; Intermediate, W. F. Wheeler (*Review*), 570; Applied in War-time, Sir John Russell and others, 813
Bird: A New, from Virginia and its Fate, K. W. Haller, 463; Observations, Egyptian, 614
Birds: Attracting, W. L. McAtee, 21; Colours of, Changes in the, F. H. Test, 269; British, in 1939, 297; of South Africa, The, Dr. Austin Roberts (*Review*), 345; South African, N. B. Kinnear (*Review*), 345; British, The Handbook of, H. F. Witherby, late Rev. F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker. Vol. 4: Cormorants to Crane (*Review*), 411; of Britain (*Review*), 411; North American, More Life-Histories of, A. C. Bent, 689; Courtship and Display Among, C. R. Stonor (*Review*), 794; Sexual Display in, Dr. F. H. A. Marshall (*Review*), 794
Black Rust Control, Vocational Training and, 457
Blastocladia Pringsheimii, Life-cycle of, Elizabeth Blackwall, 495
Blockade, Food Supplies and the, 785
Blood Transfusion, History of, Dr. E. Ecale, 228
Blow-Guns for Clearing Away Dust in Factories, 259
Boats, Plank-built, Bark Canoe, Dugouts and, J. Hornell, 336
Body Build, Prof. R. Pearl, 33
Bomb 'Blast': Windows and, 435; Window Breakage by, Dr. H. Moore, 657
Books and Periodicals: for Interned Scientific Men, Dr. W. A. Wooster, 100; Sales Tax on, 192
Borden medal and prize for research in nutrition, award of the, to Prof. H. C. Sherman, 365
Botany, Fossil, Studies in, Dr. R. Crookall (*Review*), 249
Boyle, Robert, Work of, M. Schofield, 488
Brachiopod, A Lower Carboniferous, F. W. Cope, 690
Bracken, Eradication of, 682
Branchiobdellidæ from North America, C. J. Goodnight, 371
Brassica, Cytogenetics of, S. M. Sikka, 524
Brewing: Science and Practice, H. Lloyd Hind. Vol. 2: Brewing Processes (*Review*), 248; Science in (*Review*), 248
Bristol University, Damage to the great hall of, by air raid, 715
British: Museum: Library Extension, 127; (Natural History), Acquisitions, 162; Gift of T'ang Pottery to the, 262; Pharmacopœia, Changes in the, 309; Standards Institution, P. Good, 406; Flora, Additions to the, 486; Columbia University, Dr. W. A. Clemens appointed head of the zoology department of, 490; School at Athens, The Annual of the, No. 37, session 1936–37, Papers presented to Prof. J. L. Myres in honour of his 70th birthday (*Review*), 505; Fauna, The War and the, 517; Rheologists' Club, Formation of the; Prof. G. I. Taylor elected president, 518; Empire Naturalists' Association, Activities of the, 649; Agriculture in War-time, 725; Museum (Natural History): Economic Leaflets, Nos. 4, 5 and 6, 775; Rheologists' Club: Inaugural Meeting, 781
Broadcasting in India, 709
Bromine, Arc Spectrum of, Hyperfine Structure in the, Dr. S. Tolansky and S. A. Trivedi, 687
Brooklyn Polytechnic Institute, Dr. H. Mark appointed professor of organic chemistry in the, 263
Brown Rot Fungi of Fruit Trees, Dr. H. Wormald, 370
Brown University, Prof. G. Pólya appointed to the mathematics department of, 805
Budapest University, Diseases of Students in, 836
Buffalo Museum of Science, award of the Cornelius Amory Pugsley medal of the, to Prof. W. P. Alexander, 161
Building: Design and Construction: with reference to the new L.C.C. Regulations, F. J. Samuely and C. W. Hamann. Vol. 1 (*Review*), 347; Modern, Principles of (*Review*), 347
Bull- or Gopher-snakes (*Pituophis*), Variations in the, Olive Griffith Stull, 524
Burma Government, Impending retirement of Prof. D. H. Peacock from service of the, 715
Buschi: Vom Orang-Säugling zum Backenwülster, Prof. G. Brandes (*Review*), 150
Bush Differential Analyser and its Applications, The, Prof. D. R. Hartree, 319
Business: Management (*Review*), 574; Enterprise, The Economics of, Prof. W. Rautenstrauch (*Review*), 574

Calculus, Advanced, Dr. C. A. Stewart (*Review*), 730
Californian Trout, J. O. Snyder, 494
Cambridge: University Botanic Garden, F. G. Preston, 126; Pleistocene Climate, A, Dr. L. Hawkes, 560; University, conferment of honorary degrees on Prof. A. M. Carr-Saunders, Prof. F. L. Hopwood and Prof. A. E. Richardson, 775
Cambridgeshire, A Flora of, with an Appendix on the Origin and Drainage of the Fens, Dr. A. H. Evans (*Review*), 250

Cameroon Mountains, A French Expedition to the, R. Paulian, 85

Camouflage: in its Application to Ships at Sea, Sir John Graham Kerr, 161; in War-time, C. H. Rowe, 168; Colour-Blindness and, 226; in Modern Warfare, Prof. T. R. Merton; the writer of the article, 429; in War-time, S. K. Thornley; C. H. Rowe, 462; The Progress of, 482; 584; in Modern Warfare, 597; Psychology and, Dr. H. J. Eysenck, 620

Canada: National Research Council of, Twenty-second annual report of the, Major-Genl. A. G. L. McNaughton, 106; Hydraulic Structures, Research in, 331; Royal Society of, annual meeting of the; Organization and work of the, Dr. R. W. Boyle, Dr. H. M. Tory presented with the Flavelle medal, 171; Principal R. C. Wallace elected president, 172; Scientific Research in, Help for, 458

Canadian: Entomological Service, Dr. A. Gibson, 90; Seismological Stations, 804

Canberra, Australia, Stone Implements from, H. P. Moss, 269

Cancer in an Oil Refinery, W. M. Gafafer and Rosedith Sitgreaves, 617

Cancer Research, a forthcoming journal, 805

Carbohydrate, Potassium and, Metabolism, Dr. A. Lasnitzki, 99

Carbon Dioxide: Velocity of Hydration of, in the presence of Extraneous Substances, E. O. Powell, 401; Hydration of, and its Influence on Germicidal Activity of Hypochlorite Aerosols, A. H. Baker and S. R. Finn, 747

Carbonic Anhydrase: Sulphanilamide as a Specific Inhibitor of, Dr. T. Mann and Prof. D. Keilin, 164; Activity of, in relation to Gastric Secretion, W. Feldberg, Prof. D. Keilin and Dr. T. Mann, 651; Keilin and Mann, 779

Cardiac Glycoside ?, A New, C. H. Williams, 303

Carnegie Institution of Washington, Year Book No. 38 of the, 399

Cast Irons in Automobile Construction, E. C. Toghill and R. V. Dowle, 208

Cations at Negatively Charged Surfaces, Concentration of, D. A. Webb and Dr. J. F. Danielli, 197

Cave Worship, Dr. R. R. Marett, 229

Cell: -Division, E. W. Sinnott and R. Black, 68; "Radiations", Prof. J. Ritchie (*Review*), 538

Cellular Respiration, Nature of the Cyanide-stable Portion of, E. A. Houghton Roberts, 461

Cellules reproductrices, l'Origine des, et le problème de la lignée germinale, Prof. L. Bounoure (*Review*), 822

Cellulose Problem in War-time, The, Dr. Julius Grant, 219

Celtic: Ornament from Elmswell, Yorks, P. Corder and C. F. C. Hawkes, 433; West, The, Prof. H. J. Fleure, 649

Central Register, The, 766

Chafer Larvæ in Africa and France, Parasites of, L. A. Moutia, 306

Chance for Everybody: A, a liberal basis for the Organization of Work, H. Dubreuil (*Review*), 284

Channel Islands, Wildfowl in the, 19

Cheese-making: Scientific Research and Control, Prof. H. D. Kay and others, 796

Chelsea Polytechnic, J. C. Crocker appointed head of the chemistry department of, 93

Chemical: Society, Advisory Research Council of the, 124; Industry, Society of, election of officers, 458; Calculations, J. G. Long and H. V. Anderson. Fourth edition (*Review*), 545; Change: The Kinetics of, Prof. C. N. Hinshelwood (*Review*), 603; Prof. E. K. Rideal (*Review*), 603; Lecture Bench, The (*Review*), 666

Chemicals of Commerce, Dr. Foster Dee Snell and Dr. Cornelia T. Snell (*Review*), 543

Chemist, The Tools of the, their Ancestry and American Evolution, E. Child (*Review*), 604

Chemistry: Physical, Practical, Dr. H. W. Melville (*Review*), 5; A New Dictionary of, edited by Dr. S. Miall (*Review*), 280; Alphabetical, Prof. J. Read (*Review*), 280; Forensic, H. T. F. Rhodes (*Review*), 414; Annual Reports on, A. A. Eldridge (*Review*). 416; Applied, Reports on the Progress of, Vol. 24 (*Review*), 416; Progress of, Annual Reports on the, for 1939, Vol. 36 (*Review*), 416; Organic, Institute of, in Moscow, 520; Colloid, a Textbook, Prof. H. B. Weiser (*Review*), 544; Hydrocarbon, a General Discussion held by the Faraday Society, April 1939 (*Review*), 544; Physical, Aids to, R. G. Austin (*Review*), 544; Thermodynamics and, Prof. F. H. Macdougall. Third edition, Prof. J. R. Partington (*Review*), 631; General, Lecture Demonstrations in, Prof. P. Arthur (*Review*), 666; Synthetic, Some Biological Applications of, Prof. J. W. Cook, 752; Organic, Qualitative, N. Campbell (*Review*), 822; of the Hemp Drugs, Prof. A. R. Todd, 829

Chemists, Compulsory Registration of, 125

Chemotherapeutic Agents, a Note on the Modelling of, Pyridine-3-sulphon-(2-pyridyl)-amide, H. McIlwain, 653

Chicago University, Dr. F. C. Koch appointed Frank P. Hixon distinguished service professor of chemistry in, 93

Children: 500 Books for, Nora E. Beust, 23; under Foster Care, J. W. Layman, 262

Chinese Lacquer Toilet-Boxes, Early, B. Gray, 719

Chlorine: Monoxide and Water, C. H. Secoy and G. H. Cady, 136; and Nitric Oxide, Reaction between, E. M. Stoddart, 592

Chloroacetic Acids, Resonance in the, R. P. Bell, 166; E. C. Baughan, 461

Cholesterol Derivatives, Formation of Insoluble Digitonides of, Dr. F. S. Spring and G. Swain, 718

Chromaticity Scales, Colour Vision and, Dr. W. D. Wright, 155; Prof. W. Peddie, 717; Dr. W. D. Wright, 718

Chromatids, Sister, Unequal Breaks in, M. Demerec and E. Sutton, 592

Chromite, Etching Reagent for, J. J. Frankel, 198

Chromosome Changes, Induced Evolution through, Dr. A. F. Blakeslee, 269; Diminution in a Plant, E. K. Janaki-Ammal, 839

Chromosomes, Salivary Gland, M. Colvin, M. Kodani and R. Goldschmidt, 269

Chromospheric Eruptions, Bright, Spectrum of, C. W. Allen, 749

Cilicia, Stone Age, M. C. Burkitt, 58

Cincinnati University, Dr. M. A. Logan appointed Andrew Carnegie professor of biochemistry in the College of Medicine of, 490

Citrus Fruit, Control of Moulds on, J. E. van der Plank, 370

City and South London Railway, Jubilee of the, 743; a correction, 805

Civic Development under War Conditions, 517

Cleveland Museum of Health and Hygiene, Dr. B. Gerhard appointed director of the, 399

Clock, Moving, The Rate of a, Prof. H. Dingle, 391

Coal: Composition of, R. Belcher and R. V. Wheeler, 525; and Coke, Analysis of, Methods of, 773

Cobalt and Pine Disease, H. H. Corner and Dr. A. M. Smith, 168

Cocarboxylase, Prof. R. A. Peters, 387

Coelacanth Fish, Latimeria, The existing, Sir Arthur Smith Woodward, 590

Coelacanthid Fish from South Africa, A Living, Prof. J. L. B. Smith, 53

Coke: and its Properties, H. J. Hodsman (*Review*), 573; The Quality of, being the Second Report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council, Dr. R. A. Mott and Late Prof. R. V. Wheeler (*Review*), 573

Colchicine Treatment of Daphnia, H. H. Durham and A. M. Banta, 170

Collection ? Where is the —, Dr. C. Davies Sherborn (*Review*), 80

Colloids, Precipitation of, by Electrolytes, H. B. Weiser and W. O. Milligan, 622

Colombia, Diet and Nutrition in, Dr. J. Bejarano, 338

Colombo Museum, P. E. P. Deraniyagala appointed acting director of the, 557

Colonial: Office appointments, 229; 428; 520; 684; 775; Secretary, Dr. H. A. Tempany appointed agricultural adviser to the, 426; Policy: The Future of, 790; During and After the War, Lord Lloyd, 833
Colon-Typhoid Group of Bacteria, Function of Nicotine Acid in the Metabolism of the, Prof. I. J. Kligler and N. Grossowicz, 652
Colour: Vision and Chromaticity Scales, Dr. W. D. Wright, 155; -Blindness and Camouflage, 226; and Music, Dr. W. D. Wright (*Review*), 475; Co-ordination, M. Sargant-Florence (*Review*), 475; Vision, Anatomical Basis of, Prof. W. E. Le Gros Clark, 558; Vision and Chromaticity Scales, Prof. W. Peddie, 717; Dr. W. D. Wright, 718
Columbia University, New York, Prof. T. Dobzhansky appointed professor of zoology in, 775
Comet Okabayasi, 650
Comet, Whipple and a new comet found, 587
Concentration Ratio, Dependence of Thermal Diffusion on the, Prof. S. Chapman, 431
Concentric Conductor Type of High-Voltage Alternators, 70
Concrete, Reinforced, Structural Hinges of, Tests of, R. W. Kluge, 276
Conservation: as a Foundation of Permanent Peace, Hon. G. Pinchot, 183; Reclamation in, Role of, J. C. Page, 204
Construction: Johnson's Materials of, rewritten and revised by Prof. M. O. Withey and J. Aston. Eighth edition (*Review*), 286; Materials of, their Manufacture and Properties, late Prof. A. P. Mills. Second, third and fourth editions, edited by H. W. Hayward. Fifth edition, rewritten and edited by Prof. L. F. Rader (*Review*), 286
Contact Catalysts, Kinetics of, and the Industrial Background, Prof. H. S. Taylor, 768
Contacts and Cultures, 698
Convective Equilibrium and Solar Limb Darkening, A. D. Thackeray, 749
Copepods, Indian, Dr. F. Kiefer, 591
Copernican: Literature, Prof. H. C. Plummer (*Review*), 343; Treatises: Three, The Commentariolus of Copernicus; The Letter Against Werner; The Narratio Prima of Rheticus, translated with Introduction and Notes by E. Rosen (*Review*), 343
Corals: of the John Murray Expedition, Prof. J. Stanley Gardiner and Peggy Waugh, 169; Reef-building, Biology of, Prof. C. M. Yonge, 433
Cornell University, Prof. P. Debye appointed professor, and chairman of the department of chemistry; Dr. B. Rossi appointed associate professor of physics, 163
Cort: Henry, Bicentenary of; Life and Activities of, Dr. H. W. Dickinson, 722
Cosmic: Ray: Particles: Heavy, Absorption of, Dr. W. Heitler, Dr. C. F. Powell and Dr. H. Heitler, 65; Specific Ionization of, Dr. R. L. Sen Gupta, 65; Intensities in relation to Cyclones and Anticyclones, Dr. Y. Nishina, Y. Sekido, H. Simamura and Dr. H. Arakawa, 95; Rays: and Poisson's Law, A. Gibert, 198; at High Altitudes, W. P. Jesse, 527; Ray Protons in Lead, Absorption of, Dr. G. D. Rochester and M. Bound, 745; Rays, Origin of, Prof. R. A. Millikan, 804
Cotton: Polyploids in, S. C. Harland, 622; Minerals in, Translocation of, Phillis and Mason, 779
Cows, Dual-Purpose, K. W. D. Campbell (*Review*), 285
Credit Problems of Families, 458
Crepis, Apomixis in, G. L. Stebbins and E. B. Babcock, 34
Crompton medal of the Institution of Automobile Engineers, award of the, to Dr. J. S. Clarke, 557
Crop Husbandry, British, An Outline of, Dr. H. G. Sanders (*Review*), 79
Crops, Cultivated, in Early England, Dr. H. Holbeck, 754
Cross, The Crooked, Very Rev. Dr. A. S. Duncan-Jones (*Review*), 409
Crustacea, Isolated White Chromatophores of, Response of, to change of Illumination, Dr. F. G. W. Knowles, 131
Crustacean Larvæ, R. Gurney and M. V. Lebour, 404
Cryolite Films on Glass Surfaces, Dr. J. Weir French, 687
Crystalline Surfaces, Grinding and Scratching, R. S. Rivlin, 806
Crystallography, Elementary, Dr. J. W. Evans and Mrs. G. M. Davies. Second edition (*Review*), 544
Cultural Unity in the Americas, 673
Culture: in Scandinavia, Continuity of, A. W. Brøgger; A. Steensberg, 67; Freedom and, Prof. J. Dewey (*Review*), 815
Cultures, Contacts and, 698
Cyanide-stable Portion of Cellular Respiration, Nature of the, E. A. Houghton Roberts, 461
Cyclol C_2 Skeleton, A Patterson Analysis derived from the, D. Riley, 231
Cylinders of Soft Materials, Compression of, Dr. G. W. Scott-Blair and F. M. V. Coppen, 840
Cypriot Jugs, Iron Age, J. A. Stewart, 689
Cysteine, Cystine and, Anærobic Degradation of, Desnuelle and others, 139
Cystine and Cysteine, Anærobic Degradation of, Desnuelle and others, 139
Cytoplasm, Increase in Ultra-Violet Absorption of, after Therapeutic X- and Gamma-Irradiation, Dr. J. S. Mitchell, 272
Czech Culture under German Rule, Dr. Beneš, 126
Czechoslovakia, German Culture in, 614

Dairy Cattle and Milk Production, Dr. C. H. Eckles. Third edition, revised by E. L. Anthony and Prof. L. S. Palmer (*Review*), 285
Daphnia, Colchicine Treatment of, H. H. Durham and A. M. Banta, 170
Darwin, Erasmus, William Withering and, Drs. Ruth Musser and J. C. Krantz, jun., 398
Decapod Crustacea, Correlation between Egg-carrying Setæ and Cement Glands in, A. J. Lloyd and Prof. C. M. Yonge, 334
Decontamination of Electrical Equipment, 468
Dehra Dun, Forest Research Institute, programme of work for 1940–42, 835
Demethylation in the Animal Body, Evidence of, S. W. Stroud, 166
Democracy, Ideals of, President Roosevelt, 124
Determinants and Matrixes, Dr. A. C. Aitken (*Review*), 665
Diabetics, Extra Fat Allowance for, 196
Diatom, Peculiar Water Relations of a, D. Bhatia, 591
Diborane Diphosphine, L. Gamble and P. Gilmont, 69
Dielectrics, Solid, Electric Strength of some, 594; A. E. W. Austen and S. Whitehead, 595
Differential Equations, Ordinary, Integration of, Dr. E. L. Ince (*Review*), 665
Diffusing Factor Preparations, Mucolytic Activity of, J. Madinaveitia, Prof. A. R. Todd, A. L. Bacharach and M. R. A. Chance, 197
Diffusing Factors, Madinaveitia and others, 68
Digitonides, Insoluble, Formation of, of Cholesterol Derivatives, Dr. F. S. Spring and G. Swain, 718
Dionne Quintuplets, The, 587
Dioscorea in the East, An Account of the Genus, Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary, Sir David Prain and I. H. Burkill (*Review*), 503
Diphenyl Octatetraene Crystals, Dimorphism of, Prof. K. S. Krishnan, S. L. Chorghade and T. S. Ananthapadmanabhan, 333
Dipole: Moments and Structures, C. P. Smyth, G. L. Lewis, A. J. Grossman and F. B. Jennings, 136; Moment, Ionic Character and, F. T. Wall, 271
Direct: and Alternating Currents: Theory and Machinery, E. A. Loew. Second edition (*Review*), 668; Current Machinery, Prof. H. S. Bull (*Review*), 668
Direction Indicator for an Aeroplane, A new, Dr. D. Luck, 299
"Discovery" Expedition, Crinoids from the, D. Dilwyn John, 236
Divining Rod, The Physics of the, J. C. Maby and T. B. Franklin (*Review*), 150

Drosophila: Species the F_1 Hybrids of which are Sterile, Recombinants between, Dr. H. J. Muller and Dr. G. Pontecorvo, 199; Chromosomes of; Structural Changes in the, Dr. H. J. Muller, 236; Straw Locus in, Somatic Mutations of the, Dr. C. H. Waddington, 335; Development of Wings in, Dr. C. H. Waddington, 689
Drug Cultivation, Empire, 454
Drugs and War-time Alternatives, 496
Dublin Institute for Advanced Studies, Foundation of the, Prof. E. Schrödinger appointed senior professor in the School of Theoretical Physics, 679
Dust, Screened, and its Uses, W. B. Strain, 610

Earth: Science: a Physiography, G. L. Fletcher (*Review*), 80; Tremors in Great Britain, 128; Physics of the, 7: Internal Constitution of the Earth, Edited by Prof. B. Gutenberg (*Review*), 181; The Interior of the, Prof. A. Holmes (*Review*), 181; R. Stoneley, 203
Earthing, Practical Aspects of, E. Fawssett, H. W. Grimmitt, G. F. Shorter and Dr. H. G. Taylor, 623
Earthquake: in Tibet, 128; work at Toledo, Spain, 337; Aleutian Islands, 592; Imperial Valley (California), 622; in Rumania, 647; the Rumanian, of November 10, E. Tillotson, 675; in Chile, 775; Travel-times and Structure South of St. Louis, E. J. Walter, 809
Earthquakes: Recent, 93; Registered at Hong Kong, 93; in the Aleutian Islands, 102; Recent, 196; July, Registered at Kew, 263; of South and Central America, B. Gutenberg and C. F. Richter; H. H. Heck, 270; Japanese, January–June 1939, 307; of the U.S. Atlantic Coastal Plain, H. H. Heck, 307; July, 364; Registered at Hong Kong, 405; and Structures, D. L. Thornton, 437; Recent, 490; in Rumania and Turkey, 615; during October, 719; Registered in Switzerland, 720; Recent, 803
Earth's Crust, Adjustments of the, Physical Controls in, Prof. N. L. Bowen, 563
East: African Islands, Faunistics and Ages of the, R. E. Moreau and R. H. W. Pakenham, 462; Africa, Electric Supply in, 836
Easter Island: Ethnology of, A. Métraux, 465; Origins, 465
Echinoderms from the John Murray Expedition, T. Mortensen; H. L. Clark, 33
Eclipse, A Non-Historical, C. J. Westland, 718
Economic Resources and their Employment, Dr. W. C. Mitchell, 575
Education: Elementary, What is it?, 489; for the Future, 695; for Democracy in Our Time, Prof. J. H. Newton (*Review*), 696
Educational Facilities for the Armed Forces, F. W. D. Bendall appointed adviser, 396
Egypt, Recent British Excavations in, Prof. A. M. Blackman (*Review*), 664
'Egyptian Blue', Examination of, by X-Ray Powder Photography, E. M. Jope and G. Huse, 26
Einstein Effect, Derivation of, from Eclipse Observations of 1936, Prof. T. Matukuma, 264
Eire, Demography of, 23
Electric: Distribution Cables, Standardizing, S. W. Melsom, 22; Power in the Ruhr, Storage of, 193; Torches, Supply of, 261; Transmission by Resonance, Origins of, Sir Joseph Larmor, 459; Power Stations Underground, 518; Fan Ventilation, 616; Power Transmission by Alternate Currents, The Principles of, H. Waddicor. Fourth edition (*Review*), 668; Generating Stations, Movable, 775; Tunnel Kilns for Firing Porcelain, H. N. Ramachandra Rao, 842; Power Stations, Heat Insulation in, E. T. Cope and W. F. Kinney, 844
Electrical: Engineering Mathematics (*Review*), 77; Engineers, Institution of, Awards of Scholarships of the, 263; Equipment, Decontamination of, 468; Effects at Chemical Boundaries, Dr. G. S. Hartley (*Review*), 536; Engineers and the War, J. R. Beard, 615; Discharges in Gases (*Review*), 729; Development in Thailand (Siam), 781; Heating, Costs of, F. D. Parker, 814
Electricity: Generating, Rising Cost of, Sir Percival Bower; F. H. Whysall, 92; Static and Dynamic, Prof. W. R. Smythe (*Review*), 446; Problems in Germany, 565
Electrification, Rural, in England, Development of, 92
Electrocapillarity: the Chemistry and Physics of Electrodes and other Charged Surfaces, Dr. J. A. V. Butler (*Review*), 536
Electrochemistry: The Principles of, Dr. D. A. MacInnes (*Review*), 534; Theoretical, N. A. McKenna (*Review*), 534; Fundamentals of, Dr. S. Glasstone (*Review*), 535; and Electrochemical Analysis, Dr. H. J. S. Sand. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests (*Review*), 543
Electrolytes, Current Distribution and Throwing Power in, Dr. A. v. Engel, 66
Electromagnetic: Microbarograph, An, 202; Levitation, 398
Electron: Microscope, A New, Drs. L. Marton and V. K. Zworykin, 35; Microscopy, Ultra-Violet and, Prof. L. C. Martin, 288; Compounds, Formation of 3/2, in Alloys of Copper, Silver, and Gold, W. Hume-Rothery, P. W. Reynolds and G. V. Raynor, 528; Diffraction Intensities, S. Fordham, 807
Electrons, Polarization of, by Double Scattering, Dr. C. B. O. Mohr and Prof. H. S. W. Massey, 264
Electroplating, Recent Advances in, 299
Element 85, Isolation of, Dr. W. Minder, 225
"Elephants and Ethnologists", W. B. Gourlay, 21
Embryological History, Dr. F. H. A. Marshall (*Review*), 348
Embryology: The Rise of, Prof. A. W. Meyer (*Review*), 348; A Manual of, the Development of the Human Body, Prof. J. E. Frazer. Second edition (*Review*), 728; Anatomical, Dr. C. H. Waddington (*Review*), 728
Enemy Aliens, Modification in the Terms for the Release of, 300
Energy: Electrical and Mechanical Transmission of, Prof. W. M. Thornton (Andrew Laing lecture), 693; The Conquest of, Prof. J. A. Crowther (*Review*), 760
Engineering: and Industrial Science: Records and Research in, a Guide to the Production, Extraction, Integrating, Storekeeping, Circulation and Translation of Technical Knowledge, Dr. J. E. Holmstrom (*Review*), 7; and Industry, Information and Progress in, Dr. S. C. Bradford (*Review*), 7; Foundation of New York, Annual Report for 1938–1939, 72; Geological Background of (*Review*), 699; Progress and the Social Order, Dr. F. B. Jewett and Dr. R. W. King, 824
Engineers, Professional, Compulsory Registration of, 89
Enzyme, Inactivation of an, E. W. Landen, 690
Epidemiology in the Army, Lt.-Col. J. S. Simmons, 228
Equations, Theory of: New First Course in the, Dr. L. E. Dickson (*Review*), 250; Prof. H. W. Turnbull (*Review*), 665
Equine Encephalomyelitis in the U.S.A., 91
Ergot, Shortage of, 19
Eriophyidæ Studies, Pts. 1–9, Dr. Keifer, 464
Eros, Use of, to Determine the Solar Parallax, Dr. H. Spencer Jones, 203
Europe: The Prehistoric Foundations of, to the Mycenean Age, C. F. C. Hawkes (*Review*), 213; Food Supplies and Nutrition in, 529
European Reconstruction, Food Policy and, 243
Evacuation: and Educational Policy, 439; Survey: a Report to the Fabian Society, edited by R. Padley and Margaret Cole, 439; of the Very Young, 593

Family Allowances, Pamphlet on, 57; (*Review*), 381
Fanning Island, Archæology of, K. P. Emory, 494
Farm: Woodlands, The Management of, C. H. Guise (*Review*), 475; Management: In-going and Outgoing, Insurance, Income Tax, Credit and Farm Records, K. W. D. Campbell (*Review*), 601

Farmer's Guide, Fifteenth issue of the, 399
Farming: Without Soil, Sir John Russell, 448; as a Business, W. Mansfield (*Review*), 601
Fat: an Index of Œstrogen and Progestogen Activity in the Human Endometrium, Dr. J. Gillman, 402
Fault Formation, Plasticity Conditions for, K. Sezawa, 136
Faults, Formation of, Plasticity Conditions for the, K. Sezawa and K. Kanai, 307
Fauna: of British India, including Ceylon and Burma; Protozoa; Sporozoa, Dr. B. L. Bhatia (*Review*), 384; of the Caspian, Replenishing the, 714
Fear and Courage, The Psychology of, Dr. E. Glover, 361
Feeding-Stuffs: Animal, The Supply of, Dr. N. C. Wright, 251; Britain's Supplies of, Dr. N. C. Wright, 362; in Great Britain, Production of, Dr. N. C. Wright, 712
Ferns: Welsh, a Descriptive Handbook, H. A. Hyde and A. E. Wade, 743
Fertilization, Combined, and Apomixis, G. Gentcheff and A. Gustafsson, 434
Feulgen Reaction: with Nucleic Acid, Nature of the, C. S. Semmens, 130; H. N. Barber and J. R. Price, 335; 808
Fibroblastic Sarcomatous Cells derived from a Dibenzanthracene Mouse Tumour, Architecture of Colonies of a Pure Strain of, Dr. F. Jacoby, 301
Filament Lamps, Fire Risk from the Smashing of, 162
Films, Protective, Formation of, Dr. L. H. Callendar, 304
Fire Alarm System in the United States, F. Cushman and H. A. Friede, 408
Fish: Conservation, Land Utilization and, E. Higgins, 206; Freezing and Cold Storage of, G. A. Reay, 782
Fisheries Research in Hong Kong, Dr. Lin, 207
Fishes, Indian, of Economic Value, 657
Fitzwilliam Museum, Cambridge, Accessions to the, 126
Flax Crop, Prevention of Seedling Blight in the, A. E. Muskett and J. Colhoun, 32
Flies, British Blood-sucking, Dr. F. W. Edwards, H. Oldroyd and Dr. J. Smart (*Review*), 447
Flooded Power Station, A, F. A. Matthews, 364
Flour: White, Reinforced, Dr. T. Moran and Prof. J. C. Drummond, 117; Diastatic Activity of, Damaged Starch and the, C. R. Jones, 202; Vitaminization, Advisory Committee, assistance of specialists to the, 684
Fluids, Ore-forming, Nature of, L. C. Graton, 68
Fluorescence, Photosynthesis and, E. D. McAlister and J. Myers, 621
Fluorine in Industry, Exposure to, W. Machle and E. E. Evans, 330
Folklore, English, Christina Hole (*Review*), 215
Food: and Welfare, F. L. McDougall (*Review*), 243; Policy: and European Reconstruction, 243; 258; Control, its Public Health Aspects, Dr. J. H. Shrader (*Review*), 385; Supplies and Nutrition in Europe, 529; from Producer to Consumer (*Review*), 632; Supplies in Peace and War, Britain's, C. Smith (*Review*), 632; Production in Great Britain and in Western Europe, Sir John Russell, 702; Supplies and the Blockade, 785
Foreign Policy, Speeches on, Viscount Halifax. Edited by H. H. E. Craster (*Review*), 789
Forest: Resources, Conservation of, C. L. Forsling, 204; Soils, Certain, in the Adirondack Section, Cation Exchange Properties of, R. F. Chandler, jun., 434; Research in India and Burma, Part 1, 1938–39, 519
Forestry, Colonial, and Countryside Problems, 567
Forthcoming Books of Science, 547
Fossil Orthoptera Ensifera, Dr. F. E. Zenner. Text and Plates (*Review*), 150; Plants, An Introduction to the Study of, Prof. J. Walton (*Review*), 249; Primate, New, from Sterkfontein, South Africa, J. C. Middleton Shaw, 489; Birds of North America, Check-List of, A. Wetmore, 561
Fowl, Genetics of the, F. B. Hutt and W. F. Lamoreux, 236; Leukosis *in vitro*, Cultivation of the agent of, Prof. L. Doljanski and M. Pikovski, 302
Français, Les, de Grande Bretagne, André Labarthe, 329
France, Depopulation in, Dr. H. Birnbaum, 427
France Libre, La, No. 1, 742
Fraunhofer Lines, Faint, Variation of, M. G. Adam, 780
Freedom: Man's Passion for, General Smuts, 124; and Culture, Prof. J. Dewey (*Review*), 815
Freehand Drawing and Pictorial Illustration for Draughtsmen, W. H. Kerry and E. W. Stott, 457
French: Men of Science in Britain, 73; Scientific Services in Britain, Organization of, 89; Commission gold medal, award of the, to Dr. J. Raynal, 836
Friction and Surface Finish, Prof. J. C. Hunsaker, 138
Frogs, Origin of, D. M. S. Watson, 404
Fuel and Allied Industries, Guide to, 397
Fungi, Higher, Constituents of the, L. C. Cross, C. G. Eliot, Prof. I. M. Heilbron and E. R. H. Jones, 102
Fungicidal Fertilizer, A, S. C. Teng, 102
Fur Animals, Nutrition of, C. E. Kellogg, 364

Galactic: Clusters, A Photographic Survey of, G. Alter, 69; Rotational Constant, The *K* term and the, Dr. W. M. Smart, 103
l-Galactose as a Component of a Polysaccharide of Animal Origin, D. J. Bell and Dr. E. Baldwin, 559
Galapagos: Finches, Evolution of the, D. Lack, 324; a Zoological Landmark, 803
Gall Midge of Grasses, Greenkeeping Matters and the, 261
Garden Plants of the Future, F. Kingdon Ward, 34
Gases: Van der Waals Adsorption of, S. Brunauer, L. S. Deming, W. E. Deming and E. Teller, 371; Kinetic Theory of; An Introduction to the, Sir James Jeans (*Review*), 535; Prof. S. Chapman (*Review*), 535; Electrical Discharge in, Fundamental Processes of, Prof. L. B. Loeb (*Review*), 729
Gastric Secretion, Activity of Carbonic Anhydrase in relation to, W. Feldberg, Prof. D. Keilin and Dr. T. Mann, 651
Genes, Pleiotropic Effect of, J. J. Schwab, 102
Genetics: and Long-day Plants, T. M. Little, J. H. Kantor and B. H. Robinson, 135; and Plant-breeding, J. B. Hutchison; V. G. Panse, 404; and the Study of Development, Prof. J. B. S. Haldane (*Review*), 413
Geology: and Early Man: I, T. T. Paterson, 12; II, T. T. Paterson, 49; and Engineering, Prof. R. F. Legget (*Review*), 699
Geomagnetic Research in the Americas, Dr. J. A. Fleming, 273
Geometry, Elementary (*Review*), 78
Geomorphology: A. A. Miller (*Review*), 445; an Introduction to the Study of Landscapes, Prof. A. K. Lobeck (*Review*), 445; A Textbook of, Prof. P. G. Worcester (*Review*), 445
Geophysics, Submarine Geology and, Prof. F. P. Shepard, 431; Dr. E. C. Bullard, 432
George Cross: and Medal, Institution of the, 425; award of the, to Dr. A. D. Merriman, 744
Germany: Organized Labour in, 260; Electricity Problems in, 565
Germany's Aluminium Industry, 713
Germicides on Moulds, Ability of Respiratory-stimulating Factors to overcome Toxic Action of, Prof. E. S. Cook and C. W. Kreke, 688
Gestation Period, Average, and $n\pi$, Dr. J. H. Kenneth, 620
Gibraltar, Health on, Major R. A. Mansell, 744
Glacial Deposit, Depth of, Determination of the, L. D. Leet and T. J. Smith, 810
Glasgow University, Engineering in, 487
Glass: -making in Nupe, Nigeria, S. F. Nadel, 134; Strain Testing of, Standard Disks in the, E. J. Gooding, 780; Softening Point of, Dr. J. T. Littleton, 810
Gluten Protein, Dr. A. G. McCalla and N. Gralén, 60
Gmelins Handbuch der anorganischen Chemie, Achte Auflage: System-Nummer 22, Lief. 6; Lief 7 (*Review*), 318; System-Nummer 59: Eisen. Teil FII, Lief. 2: Nachweis und Bestimmung von Fremdelementen in Eisen und Stahl; System-Nummer 59: Eisen. Teil C, Lief. 2: Prüfung der Kerbschlagzähigkeit (*Review*), 447; System-Nummer 27: Magnesium. Teil B, Lief. 4: Schluss der Verbindungen, Technische Darstellung der Magnesiumverbindungen (*Review*), 545; Achte Auflage. System-Nummer 35: Alumin-

ium. Teil A, Lief. 6 : Legierung von Aluminium mit Mangan bis Rhenium (*Review*), 668 ; Achte Auflage. System-Nummer 66 : Osmium, mit einem Anhang über Ekaosmium ; System-Nummer 68 : Platin. Teil A, Lief. 1, Teil B, Lief. 1 (*Review*), 759
Gnezdovo, U.S.S.R., Excavation at, 489
God : in a World at War, J. Hadham (*Review*), 501 ; The Plain Man and (*Review*), 501
Gold Mining in Wales, 489
Golf Green Research and the War, 194
Golgi Apparatus as an Indicator of Secretory Activity in Pancreatic Islet Cells, Dr. E. Vasquez-Lopez, 589
Grain Destruction by Insects, Dr. A. D. Imms, 238
Graphite, Hull-Debye-Scherrer Spectrum of, Anomalous Diffractions in the, A. Taylor and D. Laidler, 130
Graptolites of Australia, R. A. Keble and Prof. W. N. Benson, 561
Grasshoppers, Wild, Translocation in, M. J. D. White, 68
Grassland, Improvement of, 456
Greece : Attack on, 584 ; Appeal to mathematicians for help and sympathy for, 647 ; The Universities' debt to, 742
Greenkeeping Matters and the Gall Midge of Grasses, 261
Greenland Journey : the Story of Wegener's German Expedition to Greenland in 1930–1931 as told by members of the Expedition and the Leader's Diary. Edited by Else Wegener, with the assistance of Dr. F. Loewe. Translated by Winifred M. Deans (*Review*), 282
Group : Theory, J. H. C. Whitehead (*Review*), 44 ; Representations, The Theory of, Prof. F. D. Murnaghan ; F. G. W. Brown (*Review*), 283
Groups : Topological, Prof. L. Pontrjagin. Translated by Emma Lehmer (*Review*), 44 ; the Classical, their Invariants and Representations, Prof. H. Weyl (*Review*), 44 ; The Theory of Group Characters and Matric Representations of, Prof. D. E. Littlewood (*Review*), 699
"Growmore" Bulletin No. 3, Alice Crang and Margery Mason, 260
Growth : -Rates, Relative, Terminology of, Dr. J. Needham and I. M. Lerner, 618 ; Differential Periodic Theory of, G. F. Sleggs, 621
Gull, Black-headed, Nesting Conventions of the, F. B. Kirkman, 655
Gypsies : of the Sárrét (Hungary), I. Nagy, 305 ; Serbian, Disappearance of, Dr. A. Petrovič, 336

Hagiological Healing, C. G. Loomis, 20
Hamilton, Sir William Rowan, The Mathematical Papers of, Vol. 2 : Dynamics. Edited by Prof. A. W. Conway and Dr. A. J. McConnell (*Review*), 180
Hamilton's Dynamics, A. S. Ramsey (*Review*), 180
Harbour Engineering, Early, Sir Leopold Saville, 615
Harvard University, Dr. P. C. Mangelsdorf appointed professor of botany in, and assistant director of the botanical museum, 300
Health : and Occupation, Dr. May Smith (*Review*), 6 ; in relation to Occupation, Dr. H. M. Vernon (*Review*), 6 ; and Industry, 375
Heat Phenomenon, A New Conduction of, G. W. Stewart, 562
Hebe, Male Sterility in, O. H. Frankel, 34
Helium in Rocks, Interatomic Forces and, N. B. Keevil, 656
Heminerus deceptus Rehn, var. *ovatus*, Structure of, and the Classification of Dermaptera, P. J. Deoras, 201
Hemp : Drug Addiction in India, Brevet-Col. R. N. and Capt. G. S. Chopra, 487 ; Drugs, Chemistry of the, Prof. A. R. Todd, 829
Herbage Plants in Scandinavia and Finland, Breeding of, S. Nilsson-Leissner, F. Nilsson, E. Åkerberg, R. Torssell, H. N. Frandsen, H. Waxelsen and O. Pokjakalliv, 22[illegible]
Herbal, An Aztec, Dr. Agnes Arber, 81
Herbs, English, The Season's, 193
Heron, The Fishing, Miss A. Hibert-Ware, 235
Heterosis, I. N. Sveschnikova, 719
High : -Frequency : Apparatus, Prohibition of, 329 ; and Magnetic Fields, Biological Effects of, Dr. K. F. Nagelschmidt, 590 ; Voltage Alternators, Operating Experience with, W. D. Horsley, 70
Histamine Shock, Concentrated Plasma in, C. A. Keele and H. H. Kwiatkowski, 32
Histology, Human : a Guide for Medical Students, Dr. E. R. A. Cooper (*Review*), 385
Historian and Scientist : an Essay on the nature of History and the Social Sciences, Prof. G. Salvemini (*Review*), 179
History : and Science : F. S. Marvin (*Review*), 179 ; a Study of the relation of Historical and Theoretical Knowledge, Prof. H. Miller ; F. S. Marvin (*Review*), 316 ; The Materialist Conception of, a Critical Analysis, Dr. K. Federn (*Review*), 600
Holland, Universities of, German Treatment of the, 744
Hominidæ, Classification of, Prof. W. C. Osman Hill, 402
Hong Kong Fisheries Research Station, Journal of the, edited by Dr. G. A. C. Herklots, No. 1, 207
Hormones : Gonadotropic, in the Urine of the Giraffe, Dr. J. F. Wilkinson and P. de Fremery, 491 ; Female Sex, 624 ; Gonadotropic, Prof. P. E. Smith, 624 ; Ovarian Follicular, Prof. E. A. Doisy, 624
Hornbill's Nest, Insect Fauna of a, E. B. Britton, 33
Horticultural Research, Practical applications of, 194
House-Sparrow in New Environment, D. Lack, 809
Household Refuse, Treatment of, W. Carmichael, 83
Human : Jaw, Bony Growths in the, Dr. A. Hrdlička, 524 ; Sex Chromosome, Linkage in the, T. White, 561
Hummingbird : Anna, Note of the, T. L. Rodgers, 305 ; Flight and Habits of the, Dr. W. M. Tyler, 466
Hungary, Roadwork and Bridges in, 195
Hunger !, Heil, Health Under Hitler, Dr. M. Gumpert (*Review*), 529
Huygens, Christian, 1629–1695, A. E. Bell, 511
Hydrocarbons : Physical Constants of, Vol. 2 : Cyclanes, Cyclenes, Cyclynes and other Alicyclic Hydrocarbons, G. Egloff (*Review*), 507 ; Dr. E. F. Armstrong (*Review*), 507
Hydrogen, Perchlorides of, J. A. Wheat and A. W. Browne, 434
Hypochlorate Aerosols, Germicidal Activity of, Hydration of Carbon Dioxide and its influence on, A. H. Baker and S. R. Finn, 747
Hypophysis Secrete a Pancreotropic Hormone ?, Does the, M. Griffiths and Dr. F. G. Young, 266

Iceland, University of, Twenty-ninth anniversary of the, 59 ; P. Sigurdsson, 762
Illegitimate Child, The, C. Mullins, 298
Illinois Basin, Earthquake of November 23, 1939, H. F. Birkenhauer, 809
Immunologist, Memoirs of an, Dr. G. F. Petrie (*Review*), 761
Imperial Institute, Work of the, Sir Harry Lindsay, 626
Incendiary Bombs, A Standard of Protection against, 454
India : Population Problems in, 140 ; Political issues in, 258 ; Ancient, Racial Characters in, Dr. W. M. Krogman, 262 ; Public Health Progress in, Sir Alexander Russell, 297 ; Progress of Education in, 1932–1937, J. Sargent, 365 ; Seismological data from, 398 ; Animal Husbandry in, 457 ; Hemp Drug Addiction in, Brevet-Col. R. N. and Capt. G. S. Chopra, 487 ; Seismological data from, 556 ; Broadcasting in, 709 ; Public Health in, in 1939, 773
Indian : Population Problems, edited by Prof. G. S. Ghurye, 140 ; Timbers, Strengths of, V. D. Limaye, 228 ; Chalcid Wasps, Hem Singh Pruthi and M. S. Mani, 235 ; Statistical Conference, Second Session of the, 364 ; Philosophy : A History of, Dr. S. Dasgupta. Vol. 3 (*Review*), 446 ; Dr. T. Greenwood (*Review*), 446 ; Fishes of Economic Value, 657 ; Art and Religion, Photographic Exhibition of, address by L. S. Amery, 680 ; Association for the Cultivation of Science, Report for 1939, 714
India's Future and the Constitution, 225

Industrial: Injuries, War and, Prof. H. Levy, 242; Surveys and Reports, Prof. W. Rautenstrauch (*Review*), 419
Industry: Health and, 375; Fitness in, F. J. Pascoe, 585
Infectious Diseases and Aeroplanes, Dr. J. M. Chauvisé, 363
Infra-Red Transmission of the Human Body, C. H. Cartwright, J. Daniel and A. Petrauskas, 591
Insect: Epidemics, Sunspots and, D. S. MacLagan, 748; Pests in Stored Products, H. Hayhurst (*Review*), 757
Insulin Content of Pancreas, Species variation in the, H. P. Marks and Dr. F. G. Young, 31
Integration, Dr. R. P. Gillespie (*Review*), 665
Interior Lighting and Decoration by Fluorescence, 774
International Labour Force, An, 192
Iodine, Atomic Weight of, Baxter and Titus; Baxter and Lundstedt, 405
Ionic Character and Dipole Moment, F. T. Wall, 271
Ionospheric Observations during the Solar Eclipse of October 1, J. A. Pierce, A. J. Higgs and Dr. E. C. Halliday, 747
Ipecacuanha, The B.P. Standard for, 125
Irān, Western, Old Routes of, Sir Aurel Stein. Antiquities Examined, Described and Illustrated with the assistance of F. H. Andrews (*Review*), 537
Iris, Bulbous, Foliage Blight of the, G. W. Gibson and P. H. Gregory, 780
Iron: Age Burial, Early, Bedfordshire, C. F. C. Hawkes; A. J. E. Cave, 370; and Chromium, Alloys of: Dr. W. H. Hatfield (*Review*), 506; Vol. 2: High-Chromium Alloys, A. B. Kinzel and R. Franks (*Review*), 506; Age Settlement in Southern Britain, An, 841
Irradiated Tissue, Calculation of Energy absorbed in, Dr. F. Happey, 96
Irrigation: Research in the Punjab, 37; Primitive, in South-Western U.S.A., 617
Isis and *Osiris*, 262
Islamic Culture in London, 712
'Island' Faunas on the Mexican Plateau, Prof. E. H. Taylor, 467
Island: Years, Dr. F. Fraser Darling (*Review*), 474; Naturalist, An (*Review*), 474
Isotopes, Chemical Separation of, Dr. H. C. Urey, 434

Japanese Beetle, Feeding Habits of the, I. M. Hawley and F. W. Metzger, 306
Jericho: The History of (*Review*), 601; The Story of, Prof. J. Garstang and J. B. E. Garstang (*Review*), 601
Jewish-Christian Intermarriages in Budapest, Prof. R. Pearl, 20
Joints, Riveted, and Welded Joints, Prof. B. P. Haigh, 835
Joking Relationships, A. R. Radcliffe-Brown, 305
Jute-growing in the U.S.S.R., 684
Juvenile Delinquents, Treatment of, Dr. H. Pitoux, 298

K term, The, and the Galactic Rotational Constant, Dr. W. M. Smart, 103
Kaleidoscope, The Generalized, Prof. H. S. M. Coxeter; S. Melmore, 232
Karakoram, Map of the, 127
Kinetics of Contact Catalysts and the Industrial Background, Prof. H. S. Taylor, 768
Kingzett's Chemical Encyclopædia: a Digest of Chemistry and its Industrial Applications. Revised and edited by Prof. R. K. Strong. Sixth edition (*Review*), 280
Kitchen Waste for Feeding Farm Stock, J. Beharrell, 47

Laboratory Apparatus, History of, Dr. E. F. Armstrong (*Review*), 604
Labour under Nazi Rule, Dr. W. A. Robson, 260
Lactic: Dehydrogenase, Crystalline, Straub, 69; Acid, Radioactive, Synthesis of, G. B. Kistiakowsky and R. Cramer, 562
Lady-Bird, Genetical Studies on the, Y. Hoshino, 307
Land: The Drift from the, G. V. Jacks (*Review*), 147; Utilization and Fish Conservation, E. Higgins, 206; Use and Management, Ecological basis of, P. B. Sears, 309
Lantana aculeata, Biological Control of, C. F. C. Beeson and N. C. Chatterjee, 809
Latimeria, the surviving Crossopterygian Fish, Sir Arthur Smith Woodward, 53
Latin American-Culture, Concerning, edited by C. C. Griffin (*Review*), 674
Lattice Planes in Tin Coatings on Steel, Non-parallelism of, Dr. B. Chalmers, 493
Laue: Photograph, The Extra Spots of the, Sir William Bragg, 509; Photographs, Diffuse Reflections on, Dr. Kathleen Lonsdale, 806
Lavender Oil, Shortage of, H. S. Redgrove, 304
Lead Salts, Solubility of, S. M. Edmonds and N. Birnbaum, 720
Learning, A Tax on, 160
Leeds University: bequest to, by Sir James Baillie, 617; Union, loan of the, to the Government, 681; gift to the Brotherton library of, by Mrs. J. R. Ogden and Family, 715; H. Hartley appointed lecturer in mine surveying in, 715; Textile Studies at, 835
Leicester, A New Museum at, 587
Leisure, Juvenile, Research on, 490
Leprosy: Wheat Diet and, Dr. R. G. Cochrane, Dr. M. Paulraj and Miss M. D. Salmond, 497; in Brittany, Dr. Y. M. Marhic, 684
Leverhulme Research Fellowships, award of, to Prof. J. R. Bellerby, Dr. R. M. Davies, Dr. A. G. Gaydon, Dr. N. A. V. Piercy and W. H. Warburton, 93
Liberty, Let There Be, A. P. Herbert (*Review*), 409
Life: on other Worlds, Dr. H. Spencer Jones (*Review*), 211; The Secret of, Cosmic Rays and Radiations of Living Beings, G. Lakhovsky, translated by M. Clement (*Review*), 538
Light, Absorption of, by Interstellar Matter, Stebbins, Huffer and Whitford, 810
Linear Radiator, Field Produced by a, F. M. Colebrook, 35
Linnean Society, resignation of F. Druce of the honorary treasurership of the; election of Major F. C. Stern as his successor, 650
Little Woodbury, Wilts: Excavation at, the Settlement as Revealed by Excavation, G. Bersu, 841
Li Tribes of Hainan Island, Chungshee H. Liu, 202
Livestock Problems: War-time, Appointment of an advisory committee on, 89
Llys Helig, The Legend of, its Origin and Significance, Dr. F. J. North and W. F. Grimes, 455
Loganberry, Origin of the, M. B. Crane; P. T. Thomas, 202
Lomonosov, M. V. (1711–1765), Prof. J. D. Bernal, 16
London University: Report on the work of, 1939–40, 226; conferment on Dr. W. V. Mayneord of the title of professor, 263; College Library, Air raid damage and loss of life at, 520; conferment of the title of professor on Dr. W. V. Mayneord; award of the Sir John William Lubbock memorial prize to M. G. Pimputkar, 805
Long-Term Prisoner, The, Dr. M. Sukov, 229
Lorisoid Monkeys, Folding of the External Ear of, Prof. W. C. Osman Hill, 494
Lower Atmosphere, Ionization of the, J. J. Nolan, 720
Lucilia cuprina, Distribution of Ammonia in Larvæ of, F. G. Lennox, 268
Lymnœidæ, Blunted Teeth of, Dr. F. Gordon Cawston, 654
Lythrum Salicaria, Non-Lethality of the Mid Factor in, Prof. R. A. Fisher and Dr. K. Mather, 521

McGill University, Montreal, Dr. R. Kroner appointed professor of logic and metaphysics in, 59
McLennan: a Pioneer of Canadian Science, Lord Rayleigh (*Review*), 111; Sir John Cunningham, a Memoir, H. H. Langton. With a chapter on his scientific work by Prof. E. F. Burton (*Review*), 111
Macleod, Col. Kenneth, 90; Dr. H. Harold Scott, 201

McMath-Hulbert Observatory, The McGregor Building and Tower Telescope of the, Dr. R. R. McMath, 287
Macmillan War Pamphlets (*Review*), 409
Madras, Government Museum, Extension to the, 229
Madreporarian Corals of the "Discovery" Expedition, Prof. J. Stanley Gardiner, 67
Magnesium: Deficiency in Fruit Trees, T. Wallace; E. B. Kidston, 337; Surface of, attacked by an Aqueous Chloride Solution, An Electron Diffraction Study of the, S. Yamaguchi, 654
Maize: Cytogenetics of, E. G. Anderson and R. A. Brink, 270; Origin of, Dr. P. C. Mangelsdorf, 338; Smut Resistance and Interchanges in, C. R. Burnham and J. L. Cartledge, 622; Growing Point, A Periclinal Division in the 'Dermatogen' at the Tip of the, Dr. B. C. Sharman, 778
Malachite Green, Adsorption of, by Clays and Allied Minerals, V. L. Bosazza, 334
Malaria: in Costa Rica, A. A. Guzmán, 330; Control, A Handbook of, R. Svensson (*Review*), 823
Malayan Nature Journal, No. 1, 771
Malayan Nature Society, Inauguration of the, 771
Malaysian Mammals, Handlist of, F. N. Chasen, 689
Mammalian Palate, Evolution of the, F. R. Parrington and T. S. Westoll, 655
Mammals, Early, of South America, G. G. Simpson, 270
Man: and Society in an Age of Reconstruction: Studies in Modern Social Structure, Prof. K. Mannheim. With a bibliographical guide to the study of "Modern Society". Translated by E. Shils (*Review*), 3; -Power, Available Resources of, Sir William Beveridge appointed commissioner on, 23; Upright Posture of, Attainment of the, Prof. F. Wood Jones, 26; Early, and Pleistocene Deposits in America, F. C. Hibben, 90; -Power, Scientific, Potential and Real, 141; of the Nation, 258
Manufacturers' Order Book, by "Sala", 683
Marine Biology at Hull, Prof. A. C. Hardy, 105
Marxism: a Post-Mortem, H. B. Parkes (*Review*), 508; in History exposed, F. S. Marvin (*Review*), 600
Massachusetts Horticultural Society, award of the George Robert White medal to Sir Arthur Hill, 684
Materials, Strength of, Dr. A. Morley. Ninth edition (*Review*), 386
Maternal Constitution and Infant Mortality, H. C. Siebert, 236
Mathematical Analysis, An Introduction to (*Review*), 730
Mathematics: applied to Electrical Engineering, A. G. Warren (*Review*), 77; Elementary, from an Advanced Standpoint Geometry, F. Klein, translated by E. R. Hedrick and Prof. C. A. Noble (*Review*), 78; Advanced, Text-books of, Dr. J. A. Todd (*Review*), 665; The Symmetric Group in, G. Higman (*Review*), 699
Matter, Mind and, Dr. C. D. Darlington, 808
Medical: Service in War (*Review*), 314; Research Council, J. Gray Stuart and Sir W. Wilson Jameson appointed members of the, 365
Medicinal: Plant Cultivation, 56; Herb production in Great Britain, 397
Medicine in War-time, Prof. J. R. Marrack, 577
Meiosis: Dr. C. D. Darlington, 433; Studies of, O. H. Frankel, Dr. C. D. Darlington; Dr. C. D. Darlington and L. La Cour, 656
Melbourne University, Dr. K. E. Bullen appointed to the department of mathematics of, 458
Mental: Tests, Dr. J. I. Cohen (*Review*), 46; Disorders in Modern Life: an Outline of Hopeful Treatment, Dr. Isabel Emslie Hutton (*Review*), 547; Hygiene of Old Age, Dr. N. D. C. Lewis, 650
Merchant Shipping in War-time, 275
Merseyside, Social Statistics of, 206
Mesopotamia, Ancient, and the beginnings of Science, Prof. E. A. Speiser, 705
Metalle und Legierungen, Chemische Physik der, Prof. U. Dehlinger (*Review*), 447
Metallurgical Abstracts. Edited by S. C. Guillan. Vol. 6 (New Series), 59
Metals: Photographic Action of, J. A. Reboul, 103; The Physics of, Prof. W. L. Bragg (Norman Lockyer lecture), 275
Meteorites: British Museum (Natural History) Catalogue of, Second Appendix, M. H. Hey, 196; in the Indian Museum, Catalogue of, A. L. Coulson, 299; of the U.S.S.R., Catalogue of, L. A. Kulik, 804
Météoropathologie: Essai de, Physique, Clinique, Thérapeutique, W. Kopaczewski (*Review*), 250
Meteors, Height of, Seasoned Variation in the, R. A. McIntosh, 271
Methylboric Acid, A. B. Burg, 690
Methyl-ureas, Deliquescence in, Dr. A. Clow, 26
Mexican Plateau, 'Island' Faunas on the, Prof. E. H. Taylor, 467
Mice: Male and Female, Relative Kidney Weights of, F. L. Warren, 367; Tails of, Genetics of the, L. C. Dunn, S. Gluechsohn-Schoenheimer and V. Bryson, 689
Microbiology: A Textbook of, Prof. K. L. Burdon. Second edition of "A Textbook of Bacteriology" (*Review*), 149; Studies in, Prof. R. T. Hewlett (*Review*), 149
Micro-Diffusion: Analysis and Volumetric Error, Prof. E. J. Conway (*Review*), 113; in Chemical Analysis, Dr. J. H. Quastel (*Review*), 113
Microseisms: Origin of, J. E. Ramirez, 271; A Seismograph for, 237
Military Training for University Students, 520
Mind and Matter, Dr. C. D. Darlington, 808
Mineral: Resources of South Africa, 714; Products of the British Empire and U.S.A., Dr. W. Cullen, 772
Ministry of Health and the Board of Education, retirement of Sir Arthur MacNalty; appointment of Sir Wilson Jameson as his successor, 684
Miocene Foraminifera, Californian, Types of, F. Chapman; A. M. D., 63
Miracidia of Sheep Liver-fluke, Reactions of, H. J. Griffiths, 464
Miscegenation in South Africa, 357
Mississippi, Upper, Regulation of the, 227
Molecular: Structure, Viscosity and, Dr. H. Mark and Dr. R. Simha, 168; Fields of Force: Retrospect and Suggestions, Prof. S. Chapman, 607; 747
Molecules, Gaseous, Energy of, A. H. Heatley, 35
Molybdenum, Vanadium and, in Clays, Occurrence of, Dr. V. L. Bosazza, 746
Monocotyledons, Fructosans in the, 656
Monolayers, Mobile, Energy and Entropy of Extension and Spreading of, Prof. W. D. Harkins, Dr. T. F. Young and E. Boyd, 406
Monotremata, Development of the, Part IV, Prof. T. T. Flynn and Prof. J. P. Hill, 339
Morbidity and Death-rates in Great Britain, Dr. P. Stocks, 648
Morocco, Shrine and Market in, W. Fogg, 169
Mortality, Seasonal, in England and the United States, Dr. Lewis-Faning, 126
Mosquito: (Diptera, Culicidæ) new to Britain, A Species of, J. Staley, 368; Nuisances in Great Britain, Control of, Lt.-Col. J. A. Sinton and P. G. Shute, 683
Mould Products, Bactericidal Action of, E. C. White, 404
Mound Builders' Temple, Ohio, 455
Mucolytic Activity of Diffusing Factor Preparations, J. Madinaveitia, Prof. A. R. Todd, A. L. Bacharach and M. R. A. Chance, 197
Munition Workers: The Health and Efficiency of, Dr. H. M. Vernon (*Review*), 599; Well-being of, Sir Arthur MacNalty (*Review*), 599
Murder by Children and Adolescents, Dr. L. Begon, 456
Museums: to Commerce, Relation of, Dr. W. E. Collinge, 526; and the Public, 834
Music, Enhanced, Stereophonic Recordings of, L. Biancolli, 174
Musical Ear, The, Ll. S. Lloyd (*Review*), 476
Mycenæan Origins and Chronology, A. B. Wace, 454
Myzus, Genus, American Aphids of the, P. W. Mason, 135

National: Fruit and Cider Institute, Annual meeting of members of the, 71; Defence, A Psychological 'Hinge' in, 74; Parks in Conservation, A. B. Cammerer, 205; War Effort, Science and the, 469; Welfare, Science and, Sir William Bragg, 731; 741
Nation's Larder, The, and the Housewife's Part Therein: a set of Lectures delivered at the Royal Institution of Great Britain in April, May and June, 1940, Prof. J. C. Drummond and others (*Review*), 727
Nature and Psyche, Prof. A. D. Ritchie (*Review*), 531
Nazi and Nazarene, Monsignor Ronald Knox (*Review*), 409
Nematode Parasites of Plants, Dr. T. Goodey, 229
Nematodes, Fungus Parasites of, C. Drechsler, 336
Nervous Anatomy, Problems of, Prof. J. Boeke (*Review*), 571
Neurohistology, Problems of, Prof. D. M. Blair (*Review*), 571
Neurohumors and other Chemical Activators, Fats and Oils as Protective Repositories of, G. H. Parker, 561
Neuro-Muscular Transmission in a Crab, Depression of, by Phenothiazine, Dr. H. O. J. Collier, 232
Neutron: Loss Reaction produced by Deuterons, Mechanism of the, M. Goldhaber, 167; Radiation, Fast, Toxicity of Alpha and, R. D. Evans, 621; -Proton Scattering at High Energies, Dr. C. F. Powell, H. Heitler and Dr. F. C. Champion, 716
Neutrons: in Heavy Elements, Reactions produced by, Prof. E. Fermi, 640; Collisions of, with Deuterons and the Nature of Nuclear Forces, Prof. H. S. W. Massey and Dr. R. A. Buckingham, 776
Newcomen Society: Publications of the, 398; annual general meeting of the, Col. C. E. Davies re-elected president, 682
New: Order, President Roosevelt and the, 679; World: Order: Preparing for a, 209; Some Problems of the, Dr. G. H. Scholefield (Cawthron lecture), 225; Origins, Dr. J. G. D. Clark, 21; York: University, Washington Square College of Arts and Sciences of, Prof. C. Neuberg appointed research professor of chemistry in the, 365; World's Fair, Electric Utilities at the, G. Boyd, 487; Zealand: Department of Scientific and Industrial Research, Fourteenth annual report of the, 497; Health of, 744; World: Populations, Prof. R. Pearl, 772; 783; Order, Tradition in a, 787
Nicotiana Tabacum, Variegation in, K. R. Stino, 170
Nicotinic Acid, Function of, in the Metabolism of the Colon-Typhoid group of Bacteria, Prof. I. J. Kligler and N. Grossowicz, 652
Night: Shining Eyes, E. A. Glennie; Sir Herbert Parsons, 366; Sky: in August, 128; September, 300; October, 428; November, 557; December, 715; January, 836
Nitric Oxide, Chlorine and, Reaction between, E. M. Stewart, 592
Nobel Prize Awards, Postponement of, 520
Noise in Enclosed Spaces, Reducing, 714
Noises of Warfare, Effect of, on the Ear, Dr. T. S. Littler, 217
Nomenclator Zoologicus, Completion of the, 681
Nordic Twilight, E. M. Forster (*Review*), 409
North-East Coast Institution of Engineers and Shipbuilders, awards of the, 263
Northumberland Collections, Antiquities from the, Sidney Smith, 296
Nose-bleeding, Hereditary, H. K. Fink, 561
Notter and Firth's Hygiene, revised by L. C. Adam and E. J. Boome. Tenth edition (*Review*), 547
Nottinghamshire, The Place-Names of, J. E. B. Gover, A. Mawer and F. M. Stenton (*Review*), 820
Nuclear: Resonances, Theory of, G. Breit, 592; Forces, Nature of, Collisions of Neutrons with Deuterons and the, Prof. H. S. W. Massey and Dr. R. A. Buckingham, 776
Nuclei, Stable, Excited States of, Prof. T. R. Wilkins; Prof. J. Chadwick, 401
Nuer: Culture of the, Dr. R. R. Marett (*Review*), 568; The, a Description of the Modes of Livelihood and Political Institutions of a Nilotic People, Dr. E. E. Evans-Pritchard (*Review*), 568
Number Theory, Elementary, Prof. J. V. Uspensky and Prof. M. A. Heaslet (*Review*), 418
Numbers: Modern Elementary Theory of, Prof. L. E. Dickson (*Review*), 418; Theory of, Dr. H. Davenport (*Review*), 418
Nutrient Solution Culture of Plants, W. G. Templeman (*Review*), 633
Nutrition: and the War, Dr. G. Bourne (*Review*), 571; in War-time (*Review*), 571; The Inorganic Elements in, Prof. E. V. McCollum, 658; in the Home, Violet G. Plimmer (*Review*), 727
Nyasa, Tanganyika and, Lakes, Chemistry and Hydrography of, R. S. A. Beauchamp, 253

Oedema, Nutritional, and Dietary Deficiency, J. B. Youmans, 202
Œstrogens, Site of Action of, Dr. J. M. Robson and Dr. J. Adler, 60
Officer Cadets, University Course for, 362
Oil, A New Fine, 810
Oilfields of the United States, Dr. H. D. Miser, 437
Olivine-basalt, Crystallization of, C. A. Anderson, 236
Onions, Dried, 772
Ophiuroid, Culture *in vitro* of the Excised Embryo of an, H. B. Fell, 173
Optic Fibres in the Lateral Geniculate Body, Termination of, Dr. P. Glees, 747
Organic: Bond Strength, Influence of Substitution on, E. T. Butler and Prof. M. Polanyi, 129; Syntheses, Vol. 20 (*Review*), 823
Organisers and Genes, Dr. C. H. Waddington (*Review*), 413
Oriental Fruit Moth, Parasites of the, H. W. Allen, J. K. Holloway and G. J. Haeussler, 719
Ormskirk Potato Research Station, The, Dr. R. N. Salaman, 634
Orokolo: Drama of, the Social and Ceremonial Life of the Elema, F. E. Williams (*Review*), 380
Osiris: Vol. 7. Edited by Dr. G. Sarton (*Review*), 247; *Isis* and, 262
Osmium and Platinum, Chemistry of (*Review*), 759
Osmotic: Behaviour of some Crustacea, Influence of Temperature on, and its bearing on problems of Animal Distribution, N. K. Panikkar, 366; Regulation in Freshwater Animals, L. C. Beadle and J. B. Cragg, 588
Oxford: Electric Supply Undertaking, H. G. Fraser, 556; University, Prof. W. M. Smart appointed Halley lecturer for 1941, 805
Oxidative Phosphorylation in Brain Tissue, Nature of, Dr. S. Ochoa, 267
Oxygen, Production of, by Illuminated Chloroplasts, R. Hill and R. Scarisbrick, 61

Palæobotany, Indian, B. Sahni; R. V. Sitholey; K. S. Rao and S. R. N. Rao, 101
Palæozoic Coral Genera, Index of, W. D. Lang, S. Smith and H. D. Thomas, 195
Panama, Pre-Columbian Burial in, Dr. J. Alden Mason, 330
Pancreatic Islet Cells, Secretory Activity in, Golgi Apparatus as an Indicator of, Dr. E. Vasquez-Lopez, 589
Pancreotropic Hormone? Does the Hypophysis Secrete a, M. Griffiths and Dr. F. G. Young, 266
Para-Amino Benzoic Acid as a Bacterial Growth Factor, Dr. S. D. Rubbo and J. M. Gillespie, 838
Parachute Fishing Net, A, Dr. J. F. G. Wheeler, 683
Paramecium, Polyploidy in, Tze-Tuan Chen, 68
Paris Academy of Sciences, Prof. H. Vincent elected vice-president of the, 263
Pasteur Institute of India, Kasauli, Thirty-eighth annual report, 23
Pasture Grasses, Diseases of, Kathleen Sampson and J. H. Western, 779
Patent Office, Fifty-seventh report of the, 56
Pathology and Bacteriology, Journal of, May, 59
Patterson Analysis derived from the Cyclol C_2 Skeleton, A, D. Riley, 231

Pavlov Prize of the Academy of Sciences of the U.S.S.R., award of the, to Prof. Maria K. Petrova, 490
Peace: A Lasting, Dr. Maxwell Garnett. With some chapters on the basis of German co-operation, Dr. H. F. Koeppler (*Review*), 209; Planning, the, Sir John Herbert Parsons, 230; The Economic Basis of a Durable, J. E. Meade (*Review*), 243; Aims, 833
Pearl Formed around a Rotifer, A. E. Alexander, 370
Pectic Acid, Constitution of, S. Luckett and F. Smith, 525
Penicillin: An Enzyme from Bacteria able to Destroy, Dr. E. P. Abraham and Dr. E. Chain, 837; Morphological Effects of, on Bacteria, Prof. A. D. Gardner, 837
Penobscot Man: the Life-History of a Forest Tribe in Maine, Prof. F. G. Speck (*Review*), 386
Periodicity, Differential, Theory of, G. F. Sleggs, 495
Persia, Western, Archæological Journeys in, Sidney Smith (*Review*), 537
Personality, The Integration of the, Dr. C. G. Jung, translated by S. M. Dell (*Review*), 533
pertussis Antitoxin, Production of, D. G. Evans, 748
Pétain Government of France, dismissal of MM. Huismans, Cain, Laugier and Longchambon, 163
Petroleum: Gases, The Utilization of, Dr. A. E. Dunstan, 185; Conversion of, Production of Motor Fuels by Thermal and Catalytic Processes, Dr. A. N. Sachanen (*Review*), 507
Pharmaceutical: Examinations, New Regulations for, 296; Society's New House, 713
Pharmacopœia, British, Changes in the, 309
Phenological Records in Great Britain, 305
Phenothiazine, Depression of Neuro-Muscular Transmission in a Crab by, Dr. H. O. J. Collier, 232
Phlox, Irregular Flowers in, J. P. Kelly, 34
Phosphate Separation in Qualitative Analysis, Dr. J. Newton Friend, R. H. Vallance and H. J. G. Challis, 63
Photo-Engraving, Electrical, T. Thorne Baker, 372
Photographer Speaks, The, F. J. Mortimer and others, edited by Dr. O. Bloch (*Review*), 350
Photographic Process, The, Prof. J. E. Mack and Prof. M. J. Marton (*Review*), 350
Photosynthesis and Fluorescence, E. D. McAlister and J. Myers, 621
Physical: Education in Great Britain, Sir George Newman, 115; Problems in Industry, 125; Laboratory Practice, Modern, Prof. J. Strong and others (*Review*), 386; Society Colour Group, Formation of the, election of officers, 427
Physico-Chemical Methods, Dr. J. Reilly and Prof. W. N. Rae. Third edition. 2 Vols. (*Review*), 5
Physics, Applied, Education of Workers in, Dr. H. Lowery, 811
Physiology in Health and Disease, Prof. C. J. Wiggers. Third edition (*Review*), 80
Piedmont Glaciers, Rev. W. L. S. Fleming, 371
Pine Disease, Cobalt and, H. H. Corner and Dr. A. M. Smith, 168
Place-Names of Nottinghamshire, The, J. E. B. Gover, A. Mawer and F. M. Stenton (*Review*), 820
Planetarium, The Pinpoint, A. N. Spitz (*Review*), 350
Planning: The Sociology of, Dr. Julian Huxley (*Review*), 3; in Human Society (*Review*), 383
Plans of Men, The, Prof. L. W. Doob (*Review*), 383
Plant: Disease in relation to the Public, Prof. W. Brown (Chadwick lecture), 118; Cell Membranes, Structure and Composition of, W. K. Farr, 153; Diseases, New, W. C. Moore, 337; Protection, The Science of, Dr. E. F. Armstrong (*Review*), 569; Protection: The Scientific Principles of, with special reference to Chemical Control, Dr. H. Martin. Third edition (*Review*), 569; Physiology, Meirion Thomas. Second edition (*Review*), 823
Plasma Alkali Reserve in the Domestic Fowl, Dr. R. H. Common, 98
Platinum, Osmium and, Chemistry of (*Review*), 759
Poisons: their Isolation and Identification, late F. Bamford (*Review*), 414
Poisson's Law, Cosmic Rays and, A. Gibert, 198
Poles, Impregnation of, with Copper Sulphate, Y. Nakazima, 495
Polish Science, Future of, 425
Politics, Science and Pseudo-Science in, Mrs. Barbara Wootton (*Review*), 508
Polyisobutylene, C. S. Fuller, C. J. Frosch and N. R. Pape, 656
Polyploidy: in the Hermaphrodite Groups of Animals, Evidence for, M. J. D. White, 132; in a Prosobranch Mollusc, A Possible Case of, Prof. A. D. Peacock, 368
Polysaccharide of Animal Origin, *l*-Galactose as a Component of a, D. J. Bell and Dr. E. Baldwin, 559
Population: Policies and Movements in Europe, D. V. Glass (*Review*), 381; Ageing, Problems arising from an, Dr. L. J. Dublin, 566
Populations, Ageing of, Prof. R. Pearl, 36
Porcelain, Electric Tunnel Kilns for Firing, H. N. Ramachandra Rao, 842
Pore Fungi, Genera of the, W. B. Cooke, 405
Port Erin, Marine Biological Station, Report for 1939, Prof. J. H. Orton, 58
Portuguese Africa, Native Medicine in, L. de Pina, 67
Post-War World, Planning the, J. R. Beard, 692
Potash Alkalis, Conserving Supplies of, 363
Potassium: and Carbohydrate Metabolism, Dr. A. Lasnitzki, 99; Compounds (*Review*), 318; Heavy, in Plasma, Increase of, Dr. A. Lasnitzki and Dr. A. K. Brewer, 807
Poverty and Unemployment, Post-War, can be Prevented, T. W. Wyatt and D. Caradog Jones (*Review*), 312
Power Station Industry: History of the, Dr. A. Russell (*Review*), 146; The Early Days of the, R. H. Parsons (*Review*), 146
Præsepe Cluster, Photographic Proper Motions in the, P. C. Chaudhuri, 307
Praseodymium, Singly Ionized, Spectrographic Analysis of, G. R. Harrison and N. Rosen, 371
Prehistoric: Village Site, Ontario, 101; Times, The Study of, H. J. E. Peake (Huxley memorial lecture), 763
Pre-Portuguese Bronze Castings from Benin, Eva L. R Meyerowitz, 463
Preserves from the Garden, 260
Press, The Function of the, 39
Pressures, Very High, Attainment of, M. J. Bassett, 103
Primitive Art: Past and Future, Dr. L. Adam, 519
Probability: and Frequency, Prof. H. C. Plummer (*Review*), 114; and Relative Frequency, Dr. A. C. Aitken (*Review*), 114; Concept, The, E. C. Kemble, 464
Production Organization, The Science of, Prof. E. H. Anderson and Prof. G. T. Schwenning (*Review*), 574
Propaganda, Scientific Method in, 1
Propeller Blades, Vibration of, Kerr, Shannon and Arnold, 843
Prospodium, Rust Fungi of the genus, G. B. Cummins, 102
Protein: Solutions, Molecular and Morphological Shape of, Relations between, Dr. A. S. C. Lawrence, Dr. J. Needham and Dr. Shih-'Chang Shen, 104; Solutions with the Co-Axial (or Couette) Viscosimeter, etc., Dr. J. Needham (a correction), 399; Hydrolysates, Volatile Aldehydes liberated by Periodic Acid from, A. J. P. Martin and R. L. M. Synge, 491
Proton, Doubly-charged, The Possibility of Detecting a, by the Photographic Method, Prof. H. J. Taylor, D. Fraser and V. D. Dabholkar, 777
Protozoology, Prof. R. R. Kudo (*Review*), 80
Psychology: Experimental, Society of, award of the Howard Crosby Warren medal of the, to E. R. Hilgard, 263; and Camouflage, Dr. H. J. Eysenck, 620; in War-time, Dr. C. C. Burlingame, 712
Public: Opinion, Assessment of, 191; Health and Advertising, Dr. K. E. Miller, 456
Pueblo: Indian Irrigation Systems, G. E. Stewart, 591; Culture of Arizona, Affinities in the, 659
Punjab Irrigation Research Institute, Report for year ending April, 1938, 37
Purchase Tax: on Books, 19; and Literature, 225
Purple, Visual, Vision and the Photochemistry of, Prof. F. Weigert, 31

Puyallup-Nasqually, The, Miss Marian W. Smith (*Review*), 349
Pyrenomycetes recorded for Britain, G. R. Bisby and E. W. Mason, 748
Pyridine-3-sulphon-(2-pyridyl)-amide; a Note on the Modelling of Chemotherapeutic Agents, H. McIlwain, 653
Pyrimidines, Physiology of, Dr. L. R. Cerecedo, 274

Quadricovalent Complexes, Configurations of, G. N. Tyron and S. C. Adams, 103
Quantitative Inorganic Analysis: A Treatise on, with special reference to the Analysis of Clays, Silicates and related Minerals, late Dr. J. W. Mellor and H. V. Thompson. Second edition (*Review*), 385

Rabbit, Flemish and Smaller Types of, Fertility in, W. King Wilson, 721
Racial Freedom and the Colour Bar, Archbishop of Canterbury and others, 396
Radiation and 'Stuffiness', K. W. Yarnold and H. D. N. Fitzpatrick, 62; A. R. Pearson, 232
Radio: Echoes and Fading, J. A. Pierce and H. R. Mimno, 34; Educational, Pioneering in, Dr. C. G. Abbot, 227; Active Indicators, Mixed, in Physiological Experiments, Dr. O. Blüh, 233; Communication, Fundamental Aspects of, H. T. Stetson and others, 450
Rana pipiens Tadpoles, Tumour Induction in, R. W. Briggs, 29
Randomness as a Suggested Measure of Intelligence, Production of, Dr. R. E. D. Clark, 369
Range Conservation, R. H. Rutledge, 205
Raspberry, Selective Fertilization in the, D. Lewis, 135
Rat, 'Congenital' Copper Deposit in the, Dr. G. Brückmann and Prof. S. G. Zondek, 30
Rats, Thyroidectomized, Cardiac Metabolism and Rigor in, Dr. L. Stein and Prof. E. Wertheimer, 521
Rays, Beta and Gamma, Studies in, Prof. J. A. Gray, 171
Reading, College Student's, List of Books for a, Third edition, 299
Reconstruction: Social and Economic, 277; Leadership in, 311; and Town and Country Planning, 479; Post-War, Fundamentals in, 499
Rectifier Plant in Time of War, 397
Registration Order respecting Skilled Men, 229
Re-grassing, Sir George Stapledon, 56
Rehabilitation, Social, 471
Reinforced Concrete Design: The Essentials of, a simplified Text-book with special reference to both Old and New L.C.C. Regulations, and to the code of practice of the Building Research Board, R. F. B. Grundy (*Review*), 347
Religion: Make Your Own, A. Gowans Whyte, 486; Vital, a Brotherhood of Faith, Sir Francis Younghusband (*Review*), 543; Science and, Prof. A. Einstein, 605
Remember, When I, J. R. Clynes (*Review*), 409
Reports, Preparation of, R. Brightman (*Review*), 419
Reproduction, The Physiology of, Dr. F. H. A. Marshall (*Review*), 502
Respiration in the Higher Plant, James and James; Boswell and Whiting, 783
Retail-Store Training, K. B. Haas, 428
Rheology: The Science of, V. G. W. Harrison, 580; in Industry, J. Pryce Jones and others, 781
Rhodesia, Southern, Meteorological Report for year ended June 30, 1939, R. A. Jubb, 127
Road: Travel in Air Raids, 397; Accidents: in July, 617; Visibility and, H. H. Ferguson and W. R. Geddes, 694
Rochelle Salt, Crystal Structure of, Dr. C. A. Beevers and W. Hughes, 96
Rock Engravings on the Indus, Cuthbert King, 101
Roman Policy in Northern Britain, I. A. Richmond, 463
Rothamsted Experimental Station: Department of Plant Pathology of the, F. C. Bawden appointed head of the, 331; N. W. Pirie appointed head of the Biochemical Section of the, 554
Royal: Aeronautical Society, G. Brewer elected president of the, 19; Asiatic Society of Bengal, Year Book for 1939, 296; Society: award of Royal medals to Prof. P. M. S. Blackett and Dr. F. H. A. Marshall, the Copley medal to Prof. P. Langevin, the Rumford medal to Prof. K. M. G. Siegbahn, the Davy medal to Prof. H. C. Urey, the Darwin medal to Prof. J. P. Hill, the Sylvester medal to Prof. G. H. Hardy and the Hughes medal to Prof. A. H. Compton, 679; election of officers, 741; medal awards of the, 750; of Canada, Annual Meeting of the; Organization and work of the, Dr. H. M. Tory; Dr. R. W. Boyle presented with Flavelle medal, 171; Principal R. C. Wallace elected president, 172; of Edinburgh: Proceedings of the, 557; election of officers, 617; Horticultural Society, Dr. J. Hutchinson awarded the Loder Rhododendron cup of the, 805
Rubber: Tree, Notation for Tapping Systems of the, E. Guest, 193; Synthetic, A. E. Williams, 487
Rubus, Reproduction in, M. B. Crane; P. T. Thomas, 337
Rufford Village Museum, 519
Rumanian Earthquake of November 10, The, E. Tillotson, 675
Rumania's Cultural Losses, 362
Rural: Community Organization, Prof. D. Sanderson and Prof. R. A. Polson (*Review*), 385; High Schools, Guidance Programs for, P. Chapman, 743
Rust: Fungus, Extreme Specialization of a, Margaret Fort, 337; Fungi attacking the Thistle, Dr. M. Wilson, 779
Rye-Grass, Blind Seed Disease of, A. E. Muskett and E. L. Calvert, 200; H. H. Glasscock, 368; Dr. M. Wilson, M. Noble and E. G. Gray, 492

Sagittarii, R. W., Investigation of the Period of, P. M. Ryves, 170
St. Kilda, Birds on, E. M. Nicholson and J. Fisher, 235
Salerno, The School of, Dr. H. P. Bayon, 57
Salix Hybrids, Cytological Studies of, A. Håkansson, 464
Salt: Common, as a Preservative, J. E. Hamilton, 133; in the Plant, Upward Movement of, Prof. D. R. Hoagland, T. C. Broyer and P. R. Stout, 340
Salts: Dry, Reactions between, H. L. Link and L. J. Wood, 237; Phosphonium, Arsonium and Stibonium, J. Chatt and F. G. Mann, 525
Savoy Chapel, London, Lighting Installation of the, 331
Sciara, Evolutionary Chromosome Change in, C. W. Metz, 306
Science: Front, 1939, Dr. F. Sherwood Taylor (*Review*), 45; and the Classics, Sir D'Arcy W. Thompson (*Review*), 76; in its Infancy, Demetrius Caclamanos (*Review*), 76; Men of, and the War, 107; in War (*Review*), 112; Practical, in Schools, A. G. Lowndes, 133; and Society, Dr. F. Cyril James, 171; and Civilization, Viscount Samuel (Messel lecture), 175; The Challenge of, 175; —Curse or Blessing?, Prof. H. Levy (*Review*), 176; History: and, F. S. Marvin (*Review*), 179; of, Contributions to the, Prof. H. C. Plummer (*Review*), 247; in War Strategy, 258; Practical, in Schools, E. T. Harris, 268; The Functions of, E. F. Caldin, 403; and Crime, Prof. J. Glaister (*Review*), 414; and the National War Effort, 469; appointment of a Scientific Advisory Committee, 485; Introverted (*Review*), 533; and the Soviet Citizen, Prof. M. Ruhemann, 555; and Religion, Prof. A. Einstein, 605; Exact, in Antiquity, Dr. O. Neugebauer, 625; beginnings of, Ancient Mesopotamia and the, Prof. E. A. Speiser, 705; and National Welfare, Sir William Bragg, 731; 741
Scientific: Advancement, T. H. Hawkins (*Review*), 45; and Industrial Research, Advisory Council to the Committee of the Privy Council for, Prof. A. V. Hill, Sir Felix Pole and Sir Robert Robinson appointed members of the, 557; and Technical Books, Recent,

July 27, iv; August 31, iii; September 28, iii; October 26, 550; November 30, ii; December 28, ii; Training and Administration, W. H. Selvey, 648; Societies in War-time, 755; Equipment and the Laboratory, 805; Method, Cultural Significance of, 815
Sclerotiorine, a Chlorinated Metabolic product of *Penicillium Sclerotiorum*, Van Beyma, T. MacCurtin and Prof. J. Reilly, 335
Scottish Society for Research in Plant Breeding, report for 1940, 520
Seals, Ancient, in the Near East, R. A. Martin, 455
Sedov, The, on a New Expedition, 458
Seismicity of the Northern Pacific Coast of U.S.A., P. Byerly, 270
Seismographs, New, for Boulder Dam, 775
Seismological Observations at St. Louis, 720
Seismology: Progress in, 496; Bibliography of, E. A. Hodgson, April, May and June 1940, 744
Senecio Alkaloids, South African, Dr. H. L. de Waal, 777
Sepia, Dr. D. H. Tompsett (*Review*), 350
Sex and Reproductive Physiology, Recent Advances in, Dr. J. M. Robson. Second edition (*Review*), 502
Sheep Liver-fluke, Reactions of Miracidia of, H. J. Griffiths, 464
Sheep's Brain: Anatomy of the, a Laboratory Atlas for Students of Zoology, Prof. E. A. Briggs (*Review*), 546
Ships, Directional Stability of, Dr. Lockwood Taylor, 563
Short-Wave Emissions, Swiss, P. Borsinger, 58
Siegesbeckia orientalis in Britain, Eric Hardy, 688
Silk Fibroin, Denaturation of, Reversibility of the, C. J. Cadwallader, F. O. Howitt and S. G. Smith, 301
Silverfish Insect, Biology of the, E. Lindsay, 67
Silviculture of the Trees of Trinidad and Tobago, British West Indies, R. C. Marshall (*Review*), 546
Smokeless Air, Fourth war-time issue, 329
Smut Fungi in Egypt, Cultural Control of, G. Howard Jones and Abd El-Ghani Seif-El-Nasr Eff, 135
Snake Vessel from South-Central Africa, C. van Riet Lowe, 370
Social: Order: The New, its Mechanism. Edited by A. H. Mackmurdo, 57; and Technical Training in War-time, 420; Rehabilitation, 471; Progress ?, What is, Prof. L. J. Henderson; C. Brinton, 742; Prof. E. B. Wilson, 743; Order, Engineering Progress and the, Dr. F. B. Jewett and Dr. R. W. King, 824
Sodium Polyiodides, G. H. Cheesman, D. R. Duncan and I. W. H. Harris, 562
Sofia Central Agricultural Experiment Station, Dr. D. Kostoff appointed to the, 715
Soil: Conservation, Dr. H. H. Bennett (*Review*), 415; Conservation of the, G. V. Jacks (*Review*), 415; Bacteria and War Wounds, Dr. H. Nicol, 723
Soilless Culture Simplified, Prof. A. Laurie (*Review*), 633
Solar: Parallax, Use of Eros to Determine the, Dr. H. Spencer Jones, 203; System, Origin of the, R. A. Lyttleton, 310; Eclipse, The Total, of October 1, 1940, Prof. F. J. M. Stratton, 422; Faculæ and Solar Constant Variations, H. Arctowski, 495; Variation, Periodicities in, reflected in Weather, Dr. C. G. Abbot, 564; Eclipse: The Total, of October 1, Dr. H. Spencer Jones, 642; The Next Total, 647; of October 1, Ionospheric Observations during the, J. A. Pierce, A. J. Higgs and Dr. E. C. Halliday, 747; Limb Darkening, Convective Equilibrium and, A. D. Thackeray, 749
Solid Solutions, Crystallization Curves of, Nodal Points on, N. L. Bowen, 562
Sorghum, A. Chimæra in, J. B. Sieglinger, 656
Soul: in Western Philosophy and Science, The Idea of the, Dr. W. Ellis (*Review*), 531; of the Universe, The, G. Strömberg (*Review*), 543
Sound: Waves, Visible, A. Blackie, 369; Transmission: in Buildings: Practical Notes for Architects and Builders, R. Fitzmaurice and W. Allen (*Review*), 417; Technology of (*Review*), 417
South: Africa: The Geology of, Dr. A. L. du Toit. Second edition (*Review*), 214; Geological History and Mineral Resources of, Prof. P. G. H. Boswell (*Review*), 214; Mineral Resources of, 714; African Stone Bead Industry, H. S. Harger, 235; America, Floras of, C. B. Read, 236; M. de Oliveira Roxo, 237; -Eastern Union of Scientific Societies, meeting of June 12, 37; -West England, Outline of, in relation to Wave-attack, Muriel A. Arber, 27
Southern South America, Early Explorers of, from the United States (corrections), 650
Speech, Abnormalities of, and the Development of Language, L. Stein, 33
Spheres, Equal, Symmetrical arrangement of, S. Melmore, 199
Spiritual Values, Total War and, 771
Sponges, Fossil, A New Genus of, F. Chapman, 809
Sporozoa, Indian, Dr. C. A. Hoare (*Review*), 384
Spray Fluids, Spreading of, H. Martin, 135
Springtime the Safest Time, 93
Star, White Dwarf, Mass-Radius Relation for a, Dr. D. S. Kothari, 24
Starch: Damaged, and the Diastatic Activity of Flour, C. R. Jones, 202; Granular, Swelling of, Influence of Combined Phosphoric Acid on the, W. A. Richardson and R. S. Higginbotham, 234; Natural and Synthetic, X-Ray Comparison of, Dr. W. T. Astbury, Florence O. Bell and C. S. Hanes, 558; and its Derivatives, J. A. Radley (*Review*), 823
Stars: The Evolution of the, Prof. G. Gamow; Dr. R. A. Lyttleton and Dr. F. Hoyle, 97; Masses of the, Prof. H. N. Russell and Charlotte E. Moore, 103; Fundamental, Apparent places of, 237; Evolution of the, Dr. F. Hoyle (a correction), 458
Statistical Method from the Viewpoint of Quality Control, Dr. W. A. Shewhart, with the editorial assistance of Dr. W. E. Deming (*Review*), 150
Stearanilide, Binding of Water by, B. A. Toms, 266
Stearic Acid, Substituted Amides of, Hydration of, B. A. Toms, 560
Steel Rails, Testing, 774
Stellar Energy, Accretion and, R. d'E. Atkinson, 271
Stereochemical Types and Valency Groups, Prof. N. V. Sidgwick and H. M. Powell (Bakerian lecture), 70
Stereophonic Recordings of Enhanced Music, L. Biancolli, 174
Stone Age Industries in Wyoming, U.S.A., E. B. Renaud, 134
Stored Products, Entomology of, Prof. J. W. Munro (*Review*), 757
Strata, Orientation of, First use of Current-bedding to Determine, S. I. Tomkeieff, 369
Stratosphere, Lower, Distribution of Temperature in the, M. W. Chiplonkar, 170
Strawberry: Yellow-edge Virus, W. F. Cheal, 68; Red Core Root Disease of, C. J. Hickman, 306
Stress-Strain Diagram, A Lattice, Dr. W. A. Wood and Dr. S. L. Smith, 400
'Stuffiness', Radiation and, K. W. Yarnold and H. D. N. Fitzpatrick, 62; A. R. Pearson, 232
Sub-human Types, Classification of, Dr. R. Broom, 94
Subject Index to Periodicals, 1939 (*Review*), 630
Submarine: Valleys on the Continental Slopes of the North Atlantic, Origin of the, Prof. W. H. Bucher, 407; Geology and Geophysics, Prof. F. P. Shepard, 431; Dr. E. C. Bullard, 432; Canyons, Dr. E. B. Bailey, 493
Suez Canal, The, 647
Sugar Beet, Triploid, H. Peto and J. W. Boyes, 748
Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase, Dr. T. Mann and Prof. D. Keilin, 164
Sulphur: Dioxide, Structure of, V. Schomaker and D. P. Stevenson, 102; Heavy, Isolation of a, Dr. D. W. Stewart and Dr. K. Cohen, 555
Sun Power, Utilization of, Dr. C. G. Abbot, 744
Sunspots: during 1937, Dr. H. Spencer Jones, 136; and Insect Epidemics, D. S. MacLagan, 748; Over the Sun's Disk, Distribution of, G. H. A. Archenhold, 780
Surface Finish, Friction and, Prof. J. C. Hunsaker, 138
Surgery, Special, in War-time, D. W. C. Northfield, Dr. D. McAlpine, Dr. V. Z. Cope, T. H. Sellors and A. B. Wallace (*Review*), 822

Survivals and Beliefs (*Review*), 215
Swazi: The, an Ethnographic Account of the Natives of the Swaziland Protectorate, B. A. Marwick (*Review*), 380
Swedish Astronomer, A Great, Prof. H. C. Plummer (*Review*), 477
Swiss Postal Railway, 195
Swordfish attacking Vessels, Dr. E. W. Gudger, 261
Sydney Observatory Astrographic Catalogue, 780
Sylviculture: American Applied, Prof. E. P. Stebbing (*Review*), 701; Applied, in the United States, Prof. R. H. Westveld (*Review*), 701
Systematics, New: The. Edited by Dr. J. Huxley (*Review*), 42; Towards the, Dr. J. W. Gregor (*Review*), 42

Tanganyika and Nyasa, Lakes, Chemistry and Hydrography of, R. S. A. Beauchamp, 253
Tannic Acid Treatment of Burns, Pitfalls of the, 803
Taxonomy in the Jungle, Prof. J. Ritchie, 240
Teak Plantations, Weeding Methods in, A. L. Griffith, 91
Technical Report, Writing the, Prof. J. R. Nelson (*Review*), 419
Telephone: Calls, Supersonic Signal Method for, W. K. Brasher and B. P. Moss, 300; and Telegraph Statistics of the World, 556
Television, Significance of, W. E. Tremain, 21
Tell El-Amarna: Letters, A New Translation of the, Prof. S. H. Hooke (*Review*), 177; Tablets, The, edited by Prof. S. A. B. Mercer, with the assistance of Prof. F. H. Hallock in the final revision of the manuscript. Luxor edition. 2 Vols. (*Review*), 177
Tellurium (TeII), Ionized, Atomic Energy Values of, Dr. K. R. Rao and M. G. Sastry, 523
Temperature: Coefficients and Acclimatization, Dr. K. Mellanby, 165; Measurements in Vänern and Götaälv, Angström and Jacobson, 749
Temple (Prof. G.), Electromagnetic Theory (*Review*), 446
Termite Intercastes, New, A. M. Adamson, 655
Tertiary Volcanic Rocks of Victoria, A. B. Edwards and W. Crawford, 622
Tetrahydrofuryl-2-carbinol, Optically active, Complex Rotatory Dispersion of, M. P. Balfe, M. Irwin and Dr. J. Kenyon, 686
Thailand (Siam), Electrical Development in, 781
Thermal Diffusion, Dependence of, on the Concentration Ratio, Prof. S. Chapman, 431
Thermodynamics: and Chemistry, Prof. F. H. Macdougall, Third edition; Prof. J. R. Partington (*Review*), 631; for Chemical Engineers, Prof. H. C. Weber (*Review*), 631
Thiophosphoryl Chlorofluorides, H. S. Booth and M. C. Cassidy, 749
Thomas: Sidney Gilchrist: an Invention and its Consequences, Mrs. Lilian Gilchrist Thompson (*Review*), 245; Henry Bessemer and, Sir Harold Carpenter (*Review*), 245
Thomson, Sir J. J., obituary articles: Prof. J. A. Crowther, 351; Sir William Bragg; Lord Rayleigh; Sir William Dampier, 352; Prof. F. Soddy; Prof. E. V. Appleton, 353; Prof. W. L. Bragg, 354; Sir Owen Richardson; Dr. F. W. Aston, 355; Prof. E. A. Milne; Prof. Max Born, 356; X; Prof. E. H. Neville, 357
Thunderstorms at Karachi, B. N. Desai and S. Mal, 136
Tierischen Instinkte und ihr Umbau durch Erfahrung: Die, Eine einführung in die allgemeine Tierpsychologie, Dr. J. A. Bierens de Haan (*Review*), 317
Tikopia, Size of Family in, R. Firth, 404
Tin Mining, Cornish, C. E. N. Bromehead, 405
Tissue Culture Technique, Use of Desiccated Chick Embryo in, P. R. Peacock and R. I. Shukoff, 30
Totalitarian State, Aspects of the, F. M. Marx; Prof. T. Woody; Prof. H. Kohn; Prof. C. R. Whittlesey; M. J. Bonn; Prof. C. J. H. Hayes, 241
Town and Country Planning, Reconstruction and, 479
Tradescantia Chromosomes, X-Ray Radiation on, A. C. Fabergé, 524
Tradition in a New World Order, 787
Training Procedure, F. Cushman (*Review*), 421
Trans-Canadian Highway, The, 438
Transformer Insulating Oils, B. Calvert, 594
Transition Elements, Magnetic Properties of the, F. Bitter, 405
Travancore: Jungle People of, Marguerite Milward (*Review*), 8; Tribes and Castes, The, L. A. Krishna Iyer. Vol. 2 (*Review*), 8
Trematode, A Prolific, Miss Elizabeth Meyerhof and the Hon. Miriam Rothschild, 367
Trepanning, Primitive, S. Piggott, 616; 621
Trephining in New Britain, J. L. Meacher, 433; (a correction), 617
Trimethylcarbinol as a Cryoscopic Solvent, F. H. Getman, 720
Tristan da Cunha: and its Birds, Seton Gordon (*Review*), 821; the Lonely Isle, E. Christophersen and others, translated by R. L. Benham (*Review*), 821
Truth, The Search for, Prof. H. S. Allen, 637
Tubercularia Fungi, T. Petch, 434
Tuberculosis in Mental Hospitals, Dr. C. A. Wicks, 456
Tulipa: The genus, Sir A. Daniel Hall (*Review*), 379; The Taxonomy of, Sir William Wright Smith (*Review*), 379
Tuna, Refrigeration of, 782
Tungsten: Organic Compounds of, F. Hein and E. Nebe, 237; Parahydrogen Conversion on, D. D. Eley and Prof. E. K. Rideal, 401
Turkey: the Modern Miracle, E. W. F. Tomlin, 89
Turquet de Mayerne, Sir Theodore, Work of, Miss Irene Scoloudi, 773
Twenty Years' Crisis, 1919–1939: The, an Introduction to the Study of International Relations, Prof. E. H. Carr (*Review*), 209
Tyneside: the Social Facts, D. M. Goodfellow, 485
Typesetting, Telegraphic, H. H. Harrison; D. Murray, 713

Ultra: -Violet: Light: Fluorescence Analysis in, J. A. Radley and Dr. Julius Grant. Third edition (*Review*), 216; in Technology (*Review*), 216; Absorption of Cytoplasm, Increase in, after Therapeutic X- and Gamma-Irradiation, Dr. J. S. Mitchell, 272; and Electron Microscopy, Prof. L. C. Martin, 288; Centrifuge, The Air-driven, Dr. F. R. Eirich and Prof. E. K. Rideal, 541
Undulant Fever in Normandy, Dr. M. L. Rose-Legrand, 399
Units: M.K.S., and Dimensions and a Proposed M.K.O.S. System, Prof. G. E. M. Jauncey and A. S. Langsdorf (*Review*), 793; Electric and Magnetic, Dr. L. Hartshorn (*Review*), 793
Unity and Resolution, H.M. the King, 425
Universe? Are We Alone in the, Sir James Jeans (*Review*), 211
University: Students and Compulsory Service, Dr. R. Priestley, 162; College of Ceylon, Dr. I. Jenning appointed principal of the, 399
Uranium: Fission Products of, produced by Fast Neutrons, Dr. Y. Nishina, T. Yasaki, H. Ezoe, Prof. K. Kimura and M. Ikawa, 24; Fixation in Modern Cytological Technique, Advantages of, P. N. Bhaduri and C. S. Semmens, 100
Urea and Methyl-ureas, Deliquescence in, Dr. A. Clow, 26
U.S.A.: Equine Encephalomyelitis in the, 91; National Defence Research Committee, appointment of, 191; Vital Statistics of the, for 1938, 262; Register of Scientific Workers, 361; The Fire Alarm System in the, F. Cushman and H. A. Friede, 408; Oilfields of the, Dr. H. D. Miser, 437; Fatal Accidents in, 456; Average mortality rates for four weeks ending June 15, 458; English Sparrow in the, E. R. Kalmbach, 524; Deaths from Tuberculosis in the, in 1939, 557; President Roosevelt re-elected President of the, 614; Mortality of the, in 1940, 804; Crustal Structure of the, 809; Smallpox in the, 836
U.S.S.R.: Jews in the, 263; Folk-lore of the, 650; Jute growing in the, 684; Meteorites of the, Catalogue of, L. A. Kulik, 804

Vaghers of Okhamandal, S. T. Moses, 269

Valency: Directed, G. E. Kimbell, 69; Groups, Stereochemical Types and, Prof. N. V. Sidgwick and H. M. Powell (Bakerian lecture), 70

Vanadium: Pentoxide, Basic Nature of, O. E. Lanford and S. J. Kiehl, 525; and Molybdenum in Clays, Occurrence of, Dr. V. L. Bosazza, 746

Variations, Calculus of, Aspects of the, J. W. Green (*Review*), 250

Vector Methods: applied to Differential Geometry, Mechanics and Potential Theory, Dr. D. E. Rutherford (*Review*), 665

Vegetable: Crops, Diseases of, Prof. J. C. Walker. New edition (*Review*), 758; Pathology, D. E. Green (*Review*), 758

Vegetables, Preservation of, by Waxing, H. Platenius, 102

Vegetative Propagation in Tropical Plantations, G. St. Clair Fielden and R. J. Garner, 91

Vehicle Radio-Telephone Service, 91

Venezuela, Health Conditions in, Dr. J. G. Alvarez, 836

Ventilation of Air Raid Shelters, J. S. Weiner, 733

Venus: and Jupiter, Daylight Observation of, Dr. A. L. Peck, 162; Atmosphere of, Dr. R. Wildt, 810

Verbena: Genetics of, G. H. Beale, 495; Biochemistry of Flower Pigments in, G. H. Beale, J. R. Price and R. Scott-Moncrieff, 690

Victoria University College, Wellington, N.Z., endowment by H. Valder of a research fellowship in social relations in industry at, 519

Victory, Unfinished, A. Bryant (*Review*), 209

Virus: -infected Plants, Inclusions in the Cells of, F. M. L. Sheffield, 68; and Vital Organization, Dr. J. Grainger, 539; Problems of the, Dr. J. Grainger (*Review*), 602; The, Life's Enemy, Dr. Kenneth M. Smith (*Review*), 602

Viruses and Genes, Determination of the sizes of, by Radiation Methods, D. E. Lea, 137

Viscosity and Molecular Structure, Dr. H. Mark and Dr. R. Simha, 167

Visibility and Road Accidents, H. H. Ferguson and W. R. Geddes, 694

Vision and the Photochemistry of Visual Purple, Prof. F. Weigert, 31

Vitamin: -free Diets for Animal Experiments, A. L. Bacharach, 28; C in Plant Tissues, Co-existence of Oxidizing and Protective Mechanisms for, K. V. Giri and P. V. Krishnamurthy, 99; B_1, Biogenesis of, C. R. Harington and R. C. G. Moggridge, 134; C, Supplies of, 426; B_1 in Bread, appointment of a committee on, 617; B Complex in Normal Nutrition, The, Prof. C. A. Elvehjem, 669

War: Drunkenness and Suicide, Dr. H. K. Snell, 90; Men of Science and the, 107; Science in (*Review*), 112; Seventy Years Ago, 160; and Industrial Injuries, Prof. H. Levy, 242; Strategy, Science in, 258; Tradition and Natural Beauty, 260; Moral Issues of the, 409; with Honour, A. A. Milne (*Review*), 409; Wounds: Soil Bacteria and, Dr. H. Nicol, 723; Infection in, Control of, 753; Total, and Spiritual Values, 771; Cabinet Scientific Advisory Committee, Sir Henry Dale an *ex officio* member of the, 805

War Medicine, Bulletin of, No. 1, 585

Wargentin, Pehr Wilhelm, N. V. E. Nordenmark (*Review*), 477

Washington, Mary, College, Fredericksburg, Virginia, Prof. H. Iltis appointed professor of biology in, 775

Waste, Salvage and Utilization of; a correction, 59

Water: -Jet Pump, Metal, 127; and All its Properties, Prof. N. K. Adam (*Review*), 145; -Substance in All its Phases: Properties of Ordinary, Water-vapour, Water and all the Ices, Dr. N. E. Dorsey (*Review*), 145; Evaporation of, through Multimolecular Films, A. R. Docking, Dr. E. Heymann, Lucy F. Kerley and K. N. Mortensen, 265; Binding of, by Stearanilide, B. A. Toms, 266; -Heaters, Electric, Scale Formation in, J. F. E. Edgell, 592; Plants, Prof. J. R. Matthews (*Review*), 700

Watercress, Wild Tetraploid, Allopolyploid Nature of the, H. W. Howard and Dr. Irene Manton, 303

Watt, James, International medal, Prof. A. Stodola awarded the, 554

Weapon Types and Design, Evolution of, Brig.-Genl. E. McFarland, 774

Weather: Periodicities in Solar Variation reflected in, Dr. C. G. Abbot, 564; and Weather Prophets, Prof. D. Brunt (*Review*), 818; Forecasting, Sir Napier Shaw. Third edition, with a Supplementary Note on Sixteen Years' Progress in Forecasting Weather, by R. G. K. Lempfert (*Review*), 818; Prediction, Major R. M. Lester (*Review*), 818

Weevils, South American, of the genus Conotrachelus, Monograph of the, K. Fiedler (*Review*), 150

Welding, Resistance, 784

Welfare and Health, Report on, in relation to hours of work and output in War-time, 375

West: Indian Comptroller's Staff, S. A. A. Hammond appointed educational adviser on the, 399; Indies, Development and Welfare in the, Sir Frank Stockdale appointed comptroller for, 425

Wheat Diet and Leprosy, Dr. R. G. Cochrane, Dr. M. Paulraj and Miss M. D. Salmond, 497

Wheats, Rust-resistant, for India, Dr. K. C. Mehta and Dr. B. P. Pal, 98

Wild Life, Control of, 586

Window Breakage by Bomb-Blast, Dr. H. Moore, 657

Windows and Bomb 'Blast', 435

Winter Temperature, Analysis of, C. J. Root, 809

Withering, William, and Erasmus Darwin, Drs. Ruth Masser and J. C. Krantz, jun., 398

Witherite, Properties and Applications of, 457

Wolf-Children, Dr. J. H. Hutton, 58

Wood Charcoal: Swelling of, Experiments with a new Silica Extensometer, Dr. N. Fakhoury and Dr. M. Wahba, 63

Woodlands in Agriculture, Dr. Winifred E. Brenchley (*Review*), 475

Work: Hours of, and Efficiency, 108; Scientific Organization of, R. Brightman (*Review*), 284

Works and Buildings, The Ministry of, 661

Wound Infection: War Primer on, its Causes, Prevention and Treatment, W. H. Ogilvie, R. Cruickshank, L. P. Garrod, L. E. H. Whitby and G. A. H. Buttle, 753

Xylans in Marine Algæ, Occurrence of, V. C. Barry and Prof. T. Dillon, 620

X-Ray Photography, High-Speed, 261

X-Rays: Diffuse Reflection of, by Single Crystals, Dr. K. Lonsdale, Dr. I. E. Knaggs and H. Smith, 332; Modified Reflection of, Sir C. V. Raman and P. Nilakantan, 523; Classical and Quantum Reflections of, in Crystals, Sir C. V. Raman and P. Nilakantan, 686; Application of, to the Study of Alloys, Dr. H. Lipson, 798

Yale University, Dr. W. W. Watson appointed professor of physics in, 128

Yams, Asiatic, C. E. C. Fischer (*Review*), 503

Yellow Fever and its Control, Dr. W. A. Sawyer, 595

Youth: Welfare of, 627; Service Corps, 647

Zoologie, Handbuch der, Prof. W. Kukenthal. Herausgegeben von Dr. T. Krumbach. Bd. 3: Hälfte 2, Leif. 12; Band 3: Hälfte 2, Leif. 13 (*Review*), 504

Zoology: A Text-book of, late Prof. T. Jeffery Parker and late Prof. W. A. Haswell. 2 Vols. Vol. 1 revised by Dr. O. Lowenstein (*Review*), 442: for Students, A, Prof. C. H. O'Donoghue (*Review*), 442; A German (*Review*), 504; Laboratory Studies in, Dr. H. D. Reed and Prof. B. P. Young. Second edition (*Review*), 546

Zoos in War-time, 555

Printed in Great Britain by
Fisher, Knight & Co., Ltd., The Gainsborough Press, St. Albans

NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

Vol. 146 SATURDAY, JULY 6, 1940 No. 3688

SCIENTIFIC METHOD IN PROPAGANDA

THE word 'propaganda' is defined in the Oxford Dictionary as "an organized scheme for propagation of a doctrine or practice" ; unfortunately it has acquired a bad, and recently an even sinister, meaning. There are few things from which the scientific worker reacts more instinctively than propaganda. Indeed, his wholesome and genuine prejudice against the word has sometimes led to less than justice being done to the work and abilities of those of his colleagues who have undertaken the task of expounding or interpreting to the world the results of scientific work and their significance for human welfare. There are spheres in which the essential task of education is not readily distinguished from propaganda, and propaganda itself has its uses as well as its abuses. Even societies which exist primarily for research and inquiry may fail of their purpose if they neglect to bring to the notice of the public whatever results have been obtained.

Prejudices which refuse to recognize the right use of an instrument may have consequences as untoward as those which condone abuse, and scientific workers cannot be entirely absolved from responsibility for the consequences of neglect of the important task of exposition. It is not enough for the Government to make even full use of the service of scientific men in the evolution or execution of a policy. Co-operation of the public is also involved to the extent that it demands an intelligent understanding of the policy, and for this an immense campaign of education is essential.

In their own particular studies, scientific workers have as yet given nothing like the attention to this question that is desirable on general grounds, or, in certain fields such as food supply, that is now essential for the development of our war effort. Some aspects of this work may fairly be regarded as falling within the field of the Ministry of Information, but scientific workers are not entitled to criticize the Ministry unreservedly for shortcomings unless they have made their own contribution, or at least put forward constructive proposals. The dissemination and use of information, as much as the acquisition of information, require scientific study and the application of scientific methods.

This is not a matter which can be left entirely to information services. Their special function is the locating of information and its handling in the most efficient form. Only to a limited and technical extent are they concerned with the form in which it is presented or the use to be made of it. The educational aspect lies almost entirely outside their scope. There are features in the present situation, however, which demand the attention and co-operation of scientific workers.

The question of food supply and policy is only one, though probably the most prominent, of the matters in which inadequate use has been made of the services of scientific workers, and insufficient guidance has perhaps been given by them. Nor is it alone in being essential for the efficient prosecution of our war effort. Lord Chatfield's statement early in the year regarding the co-ordination of the scientific research carried out by the special departments of the Fighting Services and of the Ministry of Supply only partly dispelled misgiving as to the use being made of scientific services in the immediate task of national defence. In many other wide fields similar concern may be felt with even more reason. The recent report of the Industrial Health Research Board of the Medical Research Council on industrial health in war emphasized the need for applying knowledge already gained, rather than for fresh researches, and stressed the need for development of the work arising from the Health of Munition Workers Committee of 1915–17 and the Industrial Fatigue Research Board established in 1918. The report of the Barlow Commission on the distribution of the industrial population of Great Britain and the various inquiries into the success or failure of evacuation schemes provide other examples of the way in which more effective use might be made of existing scientific knowledge in the development of the national welfare, apart from the extension of that knowledge.

Scientific workers have yet to realize that they have a very large responsibility for seeing that much more adequate use is made of the knowledge which they have made available for the community. They must assist much more wholeheartedly in the interpretation of those results to the community, whether to the administrator or to the general public, in order to secure their integration into the general policy and practice of the community. The new Division for the Social and International Relations of Science of the British Association, in the various inquiries it has set going, has already made progress in this field, but much more is required. Men of science should recognize that concern with the social consequences of the application of their discoveries involves attention to the way in which these discoveries are presented to the public, in order to secure as favourable an opportunity as possible for the use of new knowledge for society's weal rather than its woe.

Interpretation or presentation in this sense is inevitably linked up with the question of education, and of securing that the education of every citizen includes at least enough teaching of general science on broad lines to fit him or her to take a place in this world of applied science and to appreciate the scientific outlook. It involves also the use of what may be called rational propaganda—the propagation by reasoned argument of the knowledge and experience and standards of conduct upon which the future of the race, if not of civilization, depends.

Significantly enough, we have come to realize, as was done some twenty-five years ago, that the successful prosecution of the War demands adequate attention to rational propaganda, not merely within our own boundaries but at least in neutral countries also. If it is neglected, or this field left entirely to our enemies, difficulties and misunderstandings may arise, engendering friction or hostility, which may react dangerously on the effectiveness of our policy. We can no more rely on the justice of our cause and the integrity of our ideals, unsupported by wise and fair exposition, to maintain the sympathy of neutrals, than the scientific worker can rely on the statement of his results before a meeting of his fellows to secure the appropriate use of his work in the service of some national interest.

The importance of propaganda as an instrument of foreign policy is well shown by Prof. E. H. Carr in one of the Oxford Pamphlets on World Affairs, in which he not only points out why democratic Governments find it necessary to control and organize opinion if they are not to be at a serious disadvantage in dealing with the Totalitarian States, but also he demonstrates the necessity for some control by the State, however discreetly veiled, over the instruments of propaganda, if the public good is to be served and the community to survive. Even in time of peace, no Government can afford to leave publicity and propaganda in the unguided hands of private interests.

Much of the interest for scientific workers of Prof. Carr's pamphlet is derived from its analysis of the limits and checks on propaganda as well as of its dangers. The tendency of education, itself an instrument of propaganda, whether rational or not, to promote a spirit of independent inquiry, is one of the strongest defences against its wrong use. Further, the more rational the methods by which propaganda is conducted and the more it is in line with the rights and interests not of a section, or class or nation, but of the world community, the more likely it is to be effective.

What has to be recognized is that, although propaganda is an instrument which can be used wisely as well as unwisely, and has its proper place in the maintenance and advancement of order and culture, it is not a scientific inquiry into truth; a balanced exposition of the evidence for or against his thesis cannot fairly be expected from the propagandist. On this ground alone, it is important that institutions such as Political and Economic Planning or the Royal Institute of International Affairs at Chatham House, which have acquired a deserved reputation for the unprejudiced investigation of social, economic and international matters, and the balanced and unprejudiced presentation and interpretation of their findings to the public, should continue their work and be supported by all those concerned in advancing the standard of education and knowledge in the community: although we may regret, perhaps unjustifiably, the closer association of Chatham House with the Foreign Office, as likely to endanger the reputation of the Institute for the impartial examination of such matters. At least it may be hoped that the criticism at present finding expression as to the mode of exposition of Allied policy and aims in the world generally, or the elaboration and execution of domestic policy in Great Britain, may remind the powers that be that scientific workers recognize responsibilities in such fields which they are eager to discharge.

THE SOCIOLOGY OF PLANNING

Man and Society in an Age of Reconstruction
Studies in Modern Social Structure. By Karl Mannheim. With a Bibliographical Guide to the Study of "Modern Society". Translated from the German by Edward Shils. Pp. xxii + 469. (London: Kegan Paul and Co., Ltd., 1940.) 16*s.* 6*d.* net.

PROF. MANNHEIM'S book, we may prophesy, is likely to become the planners' bible, for nowhere else can one find such a complete, up-to-date and well-reasoned analysis of the inevitability of planning, good and bad, and of its techniques. It is, however, more than this rather irreverent comparison would suggest. It is a compendium of modern sociological fact and theory, abundantly documented, woven round the central theme of the planned world's dawning.

Prof. Mannheim was one of the leading sociologists in Germany. With the advent of the Nazi regime, however, he came to Great Britain, and has since been teaching at the London School of Economics. The present volume is a revised and much enlarged edition of an earlier German work published in Holland five years ago. This, as Dr. Mannheim says in his preface, was written when he was "completely under the influence of experiences bred by the disintegrating tendencies of liberal society". He saw how, under certain conditions, the planlessness of the liberal order turned into anarchy. Since then, however, he has been living "in a country where liberal democracy functions almost undisturbed". This enabled him to free himself from his deep-rooted scepticism as to the vitality of democracy in our age. From one aspect, the present volume has become a study, by no means pessimistic, of how planning and order may be combined with the essentials of democracy and freedom.

The formidable extent of the author's learning and background may be gauged by the fact that no fewer than seventy-two pages are taken up with what he calls a "purely personal bibliography", itself elaborately arranged under subjects and subheads.

No reviewer can pretend to give an adequate account of this lengthy and tightly packed book; but a brief summary of the main themes of its six parts will give some idea of its scope.

The first part is a study of the rational and irrational elements in modern social existence. In the mass society of the present day, disastrous tensions develop as a result of the numerous contradictions between the high degree of rationalization in industry and its almost complete absence in politics and ordinary human behaviour. Thus industrial organization becomes a mere façade, behind which irrational force is the *ultima ratio*, both in internal and in foreign politics.

The second study deals with the role of the *élite* in society. Nineteenth century democracy was a 'minority democracy', from whose benefits large sections of the population were formally or virtually excluded. Such a society, however, had one advantage; it permitted the formation of an *élite* which had initiative and could in large measure assume the function of intellectual and cultural leadership. With the rapid transformation of 'minority democracy' to the present phase of 'mass democracy', *élites* multiply and tend to cancel each other out. Cultural leadership fails, and with it arises a widespread contempt for intellect and the things of the spirit. The obscurantist anti-scientific movement of to-day is a symptom of this phase.

Part three treats of war and dictatorship. The author rightly dismisses the idea of war arising inevitably from human aggressive instincts. The problem is how to canalize our plastic impulses so as to avoid war ; like other human problems, it is one of planning and organization. Of extreme interest is his analysis of the Fascist State as a "system of organized insecurity", arising out of the previous disintegrative condition of unorganized insecurity under the guidance of reckless, cynical and unscrupulous groups.

But if insecurity can be organized, why not security ? The discussion of this question occupies the last three parts of the book. Security cannot be organized save by conscious, rational planning ; organization in human affairs does not just happen. But can thorough-going social planning be reconciled with the basic concepts of our Western civilization ? Is it compatible with democracy in any form ?—with liberty ? We observe the planning techniques developed by the new dictatorships for the total manipulation of their peoples, we see that they are fundamentally undemocratic and destructive of human freedom, and we wonder whether this does not apply to any form of planning.

Mannheim argues cogently not merely that this is not true, but also that planning is essential for any new peaceful development (as opposed to a collapse and a slow and painful rebirth) of free human society. Organization is a mechanism, and, like any mechanism, can be used for good or for evil ends.

The liberal or *laissez-faire* age is nearing its definitive end. Mass or 'structural' unemployment cannot be overcome within the old framework. If not countered, it has a destructive effect on society, leading to mass demands for security and social justice which cannot be met except by broad planning. Already in the democratic countries, even in the New World, this is being undertaken, albeit piecemeal, in the shape of large-scale social services. The old negative type of State, concerned mainly with foreign policy and keeping the ring at home, is here giving place to what we may call the Social Service State. The planned all-round development of the Social Service State is the only alternative to the planned Totalitarian Power State—or to chaos.

It would take too long to follow Mannheim through his thorough discussion of the means by which the planned Social Service State may be nursed from its present embryonic condition into full and efficient being. One or two points, however, may be mentioned. An enlarged bureaucracy is a necessary instrument of any planned society ; he stresses the need for not allowing this to become dominant or out of hand. One safeguard against this is the presence of a strong unofficial *élite* ; this can only be maintained in a modern mass-society by an enlarged educational system with new content and aims. Here is to be found at least a partial answer to the perennial question : "Who plans the planners" ? The answer clearly is, that no one attempts such a megalomaniac task ; on the contrary, planning is a continuous and deliberate process, which demands experiment and discussion, check and countercheck. The intellectual *élite*, informed public opinion, the bureaucracy and the Government can act as checks and counterchecks on each other to ensure a balanced growth of this sort.

Finally, in an interesting section, Mannheim points out that liberty is never absolute, but always relative to the social system, and that liberty in a planned society will differ from liberty as we have become accustomed to it in a *laissez-faire* society. It is the correlative of responsibility, and a free planned society can only exist on the basis of many new responsibilities.

No single book can expect to cover this vast field fully. It seems clear that the next step must be a more concrete analysis of the problem in relation to the differences between various nations and to the particular problems before them severally and jointly. It is only a rough first approximation to speak of the Western democratic countries : France, for example, differs radically from Great Britain in many important respects of social structure and outlook, and both from the United States. Again, the relation of the various metropolitan powers to the world's backward colonial areas constitutes a special problem of its own, which the author does not touch upon.

However, for any such more detailed or more concrete studies Dr. Mannheim's book will be an indispensable basis. Metamorphosis in animals is a somewhat cataclysmic process of development. It is no less so in the development of societies. What we are accustomed to call civilization is in the midst of a metamorphosis of which the present war is a symptom. "Man and Society in an Age of Reconstruction" is one of the very few works to deal comprehensively and on an adequate basis of scholarship with this alarming but in the long run hopeful phase of human development.

JULIAN HUXLEY.

PRACTICAL PHYSICAL CHEMISTRY

Physico-Chemical Methods
By Dr. Joseph Reilly and Prof. William Norman Rae. Third edition. Vol. 1: Measurement and Manipulation. Pp. xv+686. Vol. 2: Practical Measurements. Pp. ix+580. (London: Methuen and Co., Ltd., 1940.) 84*s*. net.

PHYSICAL chemists in Great Britain have in the past usually looked to Germany for the provision of those monumental text-books which treat in exhaustive detail and with characteristic thoroughness the various branches of the subject. But in recent years there have been welcome signs that this position will not continue. The number of British texts on that increasing borderland between chemistry and physics is the best evidence that physical chemistry is at last beginning to take an independent and, it is hoped, original outlook on the matter. The two volumes under review form another addition to the ever-growing list.

"Physico-Chemical Methods" has already passed through two editions, and it was inevitable that a third edition must expand, until now the book has been split into two large volumes. The writers of such a comprehensive text are faced with difficulties unknown to the author of a specialized monograph. They cannot themselves be experimentally familiar with the whole field. Consequently they must invite collaborators to write much of the text if this is to be truly representative; at the same time, the whole must be homogeneous. Another difficulty arises in the following way. Much of the apparatus used in physical chemistry has been elaborated by commercial undertakings to such an extent that it is impossible for an ordinary laboratory to attempt to construct it. In a practical text-book, therefore, all that remains to be done is to describe how the apparatus is used; in view of the diversity of designs the authors' task is made all the more difficult. In the present book there is a judicious balance kept between these conflicting claims.

The two volumes are rather arbitrarily divided into measurement and manipulation (Vol. 1) and physical properties (Vol. 2). They are, of course, closely complementary. Vol. 1 opens, as usual, with chapters on measurements and calculations. Then follows a very short chapter on phase rule practice. Admittedly the principles of obtaining phase rule diagrams in sufficiently simple systems are easy enough, but the practice is often extremely difficult. The brevity of this chapter is compensated later on by a full discussion of evaporation and distillation. Next follow a number of chapters on apparatus and laboratory technique. Here there are some excellent up-to-date sections; for example, that dealing with pumps, but perhaps glass working might have made way for more physico-chemical technique.

There is, too, a chapter on high-pressure technique by an expert in the field. The question does arise, however, whether a person not familiar with the technique would be justified on embarking on a programme involving its use, after perusing this chapter. This does not in the least reflect on the merits of the chapter, which forms an excellent introduction to the field—more akin to precision engineering than to chemistry. In the chapters on thermometry and thermochemistry, the thermopile might have been given more prominence, as it is being increasingly used; similarly, there is no description of the disappearing filament pyrometer. Mention of the more recent types of adiabatic calorimeter would also have been welcome.

All the classical practical physical chemistry is described at length in the second volume. It is gratifying to find, too, an account of the technique for dealing with the properties and reactions of monolayers. As might be anticipated, vaporization and fractionation are dealt with in authoritative detail, the recent work on molecular stills taking due prominence in this section. Under the heading solids, mention is made of flotation; filtration, too, gets its share of space, but it is doubtful whether a description should be included of large-scale filter presses. There is also a description of the air-blown ultracentrifuge. No doubt in the next edition there will be much to be added to this section when the instrument is more fully developed.

The optical methods described are largely those of classical physical chemistry, but a supplementary volume is promised to bring this part thoroughly up to date. Once again the problem of defining the bounds of a topic arises. Infra-red, Raman and X-ray methods are mentioned. This is really all that can be done. These subjects are highly specialized, and although it is desirable that an undergraduate should have some slight experimental acquaintance with them, a detailed knowledge is not necessary.

The chapter on thermionic valves is absolutely essential, and might well be considerably extended in order that those not very familiar with the subject might be shown how to utilize with confidence these extraordinarily useful devices. The dielectric behaviour of substances is described in sufficient detail. Electrochemistry gets its quota of pages, and the useful polarograph is described in detail. The final chapter on radioactivity is brief. Perhaps here, too, the right line to take would have been to deal with natural and artificial radioactive indicators, which are becoming of ever-increasing service in all the many branches of chemistry.

As will have been gathered from these remarks, this book is of so comprehensive a scope that it must find a place on the bookshelves not only of physical chemists, but also of those who make the slightest contact with this rather ill-defined branch of science. H. W. MELVILLE.

HEALTH AND OCCUPATION

Health in Relation to Occupation
By Dr. H. M. Vernon. (Oxford Medical Publications.) Pp. viii + 355. (London: Oxford University Press, 1939.) 15*s*.

THIS book contains a valuable summary of existing knowledge on the subject of which it treats, and gives pointers to many directions in which new information is required.

Dr. Vernon investigates the relative importance of the three main factors—heredity, occupation, and social environment—on which the health of the community depends, and comes to the conclusion that occupation, though important, is of far less account in controlling health than the other two factors.

Any attempt to isolate and investigate the three factors is found to be extremely difficult, since they are almost inextricably interlocked, variation in any one factor having as a rule an indirect effect on the others. For example, the direct effects of heredity on health are shown to be inconsiderable, while its indirect effects, operating through the strongly inherited faculty of intelligence, are important; for example, the intelligent man is usually able to avoid on his own initiative many of the occupational risks to which he is exposed, while he also tends to rise to a higher grade of occupation which, being better paid, is on the whole less likely to induce ill-health.

The relative importance of heredity and environment in their effects both on health and intelligence is discussed. Researches into the characteristics of various classes of twins are described, and show that the 'nature *v.* nurture' controversy is still an open one, some investigators attributing to heredity only one half of the difference in *I.Q.* of children of the same parents reared together, others, after a study of numerous pairs of twins, making heredity three to five times more significant than environment. Perhaps it is true, as is asserted by one group of investigators of nineteen cases of identical twins reared apart, that "for twins reared together most of the differences between members of a pair may be due to the nature factor; whereas for twins reared under strikingly different environments the nurture factors will have a relatively greater influence".

Of the environmental factors which influence health, nutrition is shown to be by far the most important. Adequate nutrition is largely, though not entirely, dependent on adequate wages, which in its turn is dependent on economic causes of a controversial and complex nature. The writer reviews the problem of the nutritional standards necessary at all ages and under varying conditions of occupation; and shows that many 'protective' foods which should be included in a diet are beyond the resources of the worst paid members of the community. The ill effects of inadequate nutrition, particularly on expectant and nursing mothers, are described, and the beneficial results of certain controlled experiments examined.

In a survey of the present standard of living we find that recent investigations into the family income of working-class homes in London show that a third of them failed to reach the standard laid down by the author, while many were far below it. Wages form, in fact, the fundamental basis on which the adequacy of social environment depends; and Dr. Vernon states his belief that the greatest single factor for the improvement of the nation's health is the provision of an adequate income for all members of society.

Coming to the occupational factor, we find that, while a good deal is known about the effect of occupational conditions on mortality, we have little exact information as to their influence on health and sickness. The causes and effects of all known occupational diseases, as well as of accidents and psychological disorders, are discussed, and remedial measures suggested. But we are led to the conclusion that occupation acts on health more in an indirect manner by determining wages, and therefore social environment, than by any direct action.

Allowing for the effects of intelligence in increasing the importance of the hereditary factor, Dr. Vernon hazards the suggestion that the relative importance of the three factors may be estimated as: heredity, 40 per cent; occupation (direct effects), 10–20 per cent; and social environment, 40–50 per cent. He gives these figures as provisional, and as a challenge to criticism and a stimulus to the search for further much-needed information.

In his concluding chapter the writer discusses possible curative measures for the improvement of social conditions, and refers to plans which have been suggested by various authorities for a thorough-going revision of the health services of the nation.

May Smith.

INFORMATION AND PROGRESS IN ENGINEERING AND INDUSTRY

Records and Research in Engineering and Industrial Science

A Guide to the Production, Extraction, Integrating, Storekeeping, Circulation and Translation of Technical Knowledge. By Dr. J. Edwin Holmstrom. Pp. xii+302. (London: Chapman and Hall, Ltd., 1940.) 15*s.* net.

THE present work is a treatise on the collection and selection of information for use in the development of engineering and manufacture. Since progress in science and industry consists in the application of knowledge previously acquired, the problem of making this knowledge available in the fullest degree is a study of fundamental importance. Yet, for some reason, difficult to imagine, the laboratory worker, reading a gauge or shaking and looking at a test tube, enjoys support and prestige denied to the documentalist, engaged in processing the raw material of knowledge so obtained. Through such neglect, untold sums are wasted annually in working out engineering projects, developing inventions and conducting experimental researches which might have been saved altogether or begun from a more advanced starting point if the technique of finding out what other workers had already placed on record had been properly understood. Haphazard reading of the current issues of a few technical periodicals in moderation is not a waste of time. But, when we realize the thousands of journals, any volume of which, past or current, might contain information on a single subject, the method is seen to be essentially inefficient as a means of gathering specific information. Valuable time must not be frittered away in reading documents which are not the best for the immediate purpose.

The task of documentation is to provide a subject index that will enable us to select at will, from the millions of scientific and technical writings poured out, the particular documents relative to a specific inquiry. A single adventure in modern industry may depend for its realization on the application of the widest range of scientific and technical knowledge. Documentation needs to be organized from the point of view of science as a whole, instead of being worked in watertight compartments as at present, with a corresponding loss of efficiency.

Following useful chapters, describing in detail the present fortuitous concourse of research institutions, and the heterogeneous aggregate of "collative organisations", as the author terms them, the work passes on to discuss, in two important chapters, the methods of gathering ideas from technical literature and of sorting and integrating these ideas. The writer shows how the co-ordination of the mass of current unrelated abstracting and indexing work is being achieved gradually by the extension of the use of a standard method of classifying references. This method is the Universal Decimal Classification. Incidentally, it may be remarked that between a third and a half of the different items in scientific and technical literature indexed are now being classified by the standard method. In the Science Library at South Kensington, all references and abstracts classified in this way are cut up, mounted on cards and amalgamated in a central index of two and a half million cards, which is growing at the rate of from 120,000 to 150,000 cards annually. From this index, supplemented with a general collection of bibliographies and lists of references on all branches of science, comprehensive bibliographies on sufficiently restricted subjects of inquiry are prepared, free of charge, by an expert staff.

The book includes a description of the Kaiser System of indexing, for non-co-operative purposes, and gives due weight to economic and commercial aspects. The work appears at an opportune time, when the achievement of the greatest efficiency in documentation is essential. As an analysis of the subject and a comprehensive guide to sources of information, the volume should be in the hands of the business man, engineer, abstractor, indexer, and librarian alike.

S. C. Bradford.

JUNGLE PEOPLE OF TRAVANCORE

The Travancore Tribes and Castes

By L. A. Krishna Iyer. Vol. 2. Pp. liv + 344 + 86 plates. (Trivandrum: Government Press, 1939.)

MR. KRISHNA IYER is much to be congratulated on his lucid description of the history, customs and ceremonies of the tribes of Travancore. The careful classification of subjects makes the book of practical reference. In every way he tries to tell us the reasons and underlying ideas for the behaviour of these jungle people, all of which makes for greater interest. Each tribe section is preceded by a map showing the geographical distribution, an original and helpful arrangement. Many photographs of groups and heads aid description, and at the end of the book notes on index and stature are given. The volume is enhanced and framed as it were by an introduction written by Baron von Eickstedt, a masterly exposition of the development of Indian anthropology, and how the great Indian races have been studied, named and classified.

The ruling house of Travancore, seconded by Cochin, takes more interest in its aboriginals than any other State. They are treated as a 'backwards community' and helped in every possible way; if necessary by giving land and establishing small colonies. Travancore was our first ally to establish law and order in India in the days of Tipoo Sultan, and it is interesting to note that in 1812, the Maharani of Travancore abolished slavery entirely in her realm, anticipating the British Government in this much-needed reform. In the chapter on the Pulayas (who were originally slaves and look it) there is most interesting reading on this subject (pp. 121–129).

The historic and amazing proclamation by the present Maharaja on the right of temple entry (1936) astonished all India. It will go down to posterity as a charter of religious liberty, says Mr. Krishna Iyer (p. 129).

The author begins this volume with the Muthuvans, a most intriguing people with an aquiline nose peculiar to them. The tribe are accomplished hill men though they came from the plains. The region which is now their habitat has the most entrancing scenery of all Travancore. Their method of cultivation can be seen from any hill top, for they make clearings in the jungle like all primitives, believing that mother earth should not be slaughtered with a plough. When they have made seven 'kudis' they go back to No. 1. Their women are never or rarely seen. I believe I was the first European to be allowed to meet some and photograph them. From shyness or custom they hide in the jungle at the approach of a stranger.

There are many interesting pages about their form of worship, which is a complete mixture of Hinduism and animism (pp. 28–33). I was taken to see just such a temple to Subramani as the one described. The Muthuvans worship the sun both morning and evening. "O God we live in the jungle. We are ignorant of everything. Protect us". It is probable that this worship may at one time have formed a prominent part of their religion. Their prayers are always naïve and direct: "O God save us from elephants, pigs and panthers". "O God, my cultivation is being ruined for want of rain. It would be a good thing if it rained". There is much charm, too, in their folk-lore: "Earthquake is believed to be caused when the goddess removes the earth from one shoulder to the other because of its weight".

Palayans and Uralies are only to be found around Periyar Lake, another beauty spot in Travancore (pp. 68 and 223). Here big game can be hunted as well as tribes, for there is a five-mile preserve round the Lake. Bison and elephant come there regularly to drink; a tiger walked across my track while I was visiting a Palayan village. These isolated groups of people are extraordinarily brave. The Palayans welcomed me in a most original way; they had built a bench with a decorated canopy over it to give me shade, and their manners were charming.

Nothing more picturesque can be imagined than an Uralie hamlet; they build most of their huts in the trees, for like the Muthuvans they live in daily terror of elephant, which trample and eat up their scanty crop. Shooting wild elephant is made difficult in Travancore, for the legend runs that when elephants disappear the line of Maharajas will also cease.

The Uralie marriage laws are unique. "No man can have a wife unless he has a sister whom he can give in exchange." So far as I could discover, the unfortunate sister is left at the bride's house and has to act as daughter there (p. 229).

Mr. Krishna Iyer tells us much that is of interest about the Nayadis, a remnant of an ancient people (p. 49). Those of Cochin State are short of stature and miserable looking, and they spend their day in begging in the bazaars. Possibly even these will be reformed and civilized by a patient Government. A reform of this kind will cause no sorrow, but anything that tends to change the native dress and customs of these ancient and wonderful tribes saddens me, and I look at the photograph of the Thanta-Pulayas in their leaf garments on p. 123 with regret.

MARGUERITE MILWARD.

TREATMENT OF ABATTOIR WASTES

By J. H. Codling, M.B.E.,

City of Birmingham Salvage Department

THE products obtained from the treatment of abattoir wastes are progressively assuming greater importance in our war-time national economy. For many years several of our larger municipalities have recognized the potential value of these wastes and have acted accordingly, but there are still many authorities which even now ignore the important contribution which these wastes can be made to pay to our war effort. The reason in many cases may lie in the fact that apparently the amount of such waste is too small to warrant the installation of plant for its treatment; perhaps in other cases it is imagined that insuperable technical difficulties will beset the path.

Nature and Classes of Raw Materials

The slaughterhouse wastes usually available for treatment by municipal authorities consist of condemned meat, and the viscera consisting of the intestines, stomachs and other organs of slaughtered beasts. To this may be added, whilst not strictly abattoir waste, such materials as fish and fish offal waste. From such crude raw materials, after suitable processing, there are produced feeding meals for pigs and poultry, organic fertilizers of first-class quality, and incidental to the process there results the reclamation of the valuable fat content of the tissues which to-day is of such importance in the manufacture of explosives. Household bones recovered from house refuse may similarly be treated for the production of a fertilizer or a feeding bone meal and the recovery of bone fat.

Referring to my own experience in Birmingham, where a process known as 'Dry Rendering' is in operation, and to which the ensuing facts relate, we treat here about 5,000 tons annually of such raw materials as are included above, and produce therefrom about 1,000 tons of fertilizers or feeding stuffs and about 200 tons of fat. As glue is a material of such great importance in aeroplane manufacture, all the bones recovered from the house refuse of Birmingham are sold to firms which specialize in glue recovery; these firms simultaneously recover the grease, and the meal residue is a bone fertilizer. Otherwise, if treated, as they can be, through the ordinary process of rendering, the glue would not be recovered but left in the meal as the protein content, in which form, of course, it still serves a valuable purpose used either as a feeding meal or fertilizer. If glue recovery were desired, it would mean setting up special digestors and other plant to deal with what is, after all, only a relatively small proportion of our raw material.

Derived Products

Condemned meat is a valuable raw material, yielding as it does a valuable meat meal for feeding purposes, and fat. The carcasses are treated as received, the only preliminary treatment being the cutting up into suitable sizes for feeding into the machines employed in their processing. In round figures this material yields about 25 per cent of feeding meal and about 15 per cent fat. Again in round figures, the feeding meal, which is dried down to about 10 per cent moisture, shows on analysis about 55 per cent protein, 10 per cent oil and 9 per cent phosphoric acid. It is obvious, therefore, that this product is a highly concentrated food; it is sweet and palatable, completely sterilized, and is worth to-day about £15 per ton.

Slaughterhouse offals, consisting of ropes (intestines), farthings (stomachs), paunches and various other organs are all treated together with their ingesta for the production of a fertilizer, and the recovery of their all valuable gut tallow. Incidentally, this tallow is coloured green, due to the chlorophyll present in the food which the beast has eaten, but it is none the worse for this as the fat refiner easily bleaches it. About 20 per cent yield of fertilizer is obtained, which apart from the value displayed by its analysis has the further advantage of a high content of humus-forming material; also about 5 per cent fat is obtained. The fertilizer, dried down to about 10 per cent moisture, shows between 5 and 6 per cent nitrogen and about 3 per cent phosphoric acid; it sells at about £5 per ton. In the Birmingham process we have found it better to let the white fat recovered from condemned meat run to the same tank as the green fat from the slaughterhouse offal rather than make two fat products, although this can be done if desired.

Fish, if white, is worth treating separately from the oily fish, and can then be used as a fish feeding meal, whilst usually the product of the oily fish, after oil extraction or even without, is used as a fish manure. If the respective quantities available do not warrant separate treatment, then the whole of the fish waste is converted into a fertilizer. About 25 per cent recovery is effected and the manure will analyse 8 per cent nitrogen and 8 per cent phosphoric acid ; its value to-day is between £10 and £11 per ton.

In the case of small towns the initial segregation of the raw material into such classes as the above may not be warranted owing to the small quantities respectively available. Under such conditions the procedure of treating the whole of the raw material together for the production of fertilizer and fat is successfully practised.

PLANT AND PROCESSING

The raw material to be dealt with contains some 70–80 per cent moisture, and it is the purpose of the process to reduce this to about 10 per cent, in which condition, suitably stored, the resultant meal will keep for an indefinite period. In addition it is obviously desirable to remove as much grease as possible from the tissues. The type of plant which I consider most suitable for the use of municipalities is that known as Dry Rendering, which is the one I propose to describe.

The drying process is effected in a cylindrical steam-jacketed vessel lying horizontally (Fig. 1). This vessel is fitted with revolving arms driven by a motor which keep the contents of the vessel agitated to assist the free emission of the water vapour during the drying process. A charging hopper for the introduction of the raw material is fitted to the top and a discharging door for the removal of the finished product is fitted to one end. These machines are built in various sizes and designed to suit whatever steam pressure it is desired to employ in the jacket.

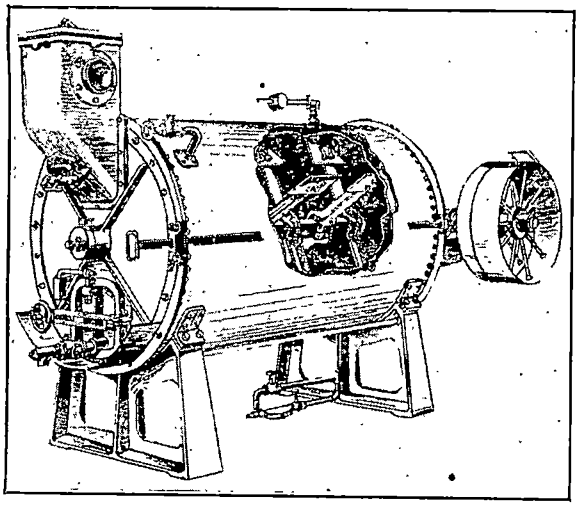


Fig. 1

DRAWING OF DRYER WITH SIDE CUT AWAY TO SHOW AGITATOR INSIDE AND STEAM JACKET. CHARGING HOPPER AND DISCHARGING DOOR ARE AT FRONT OF MACHINE.

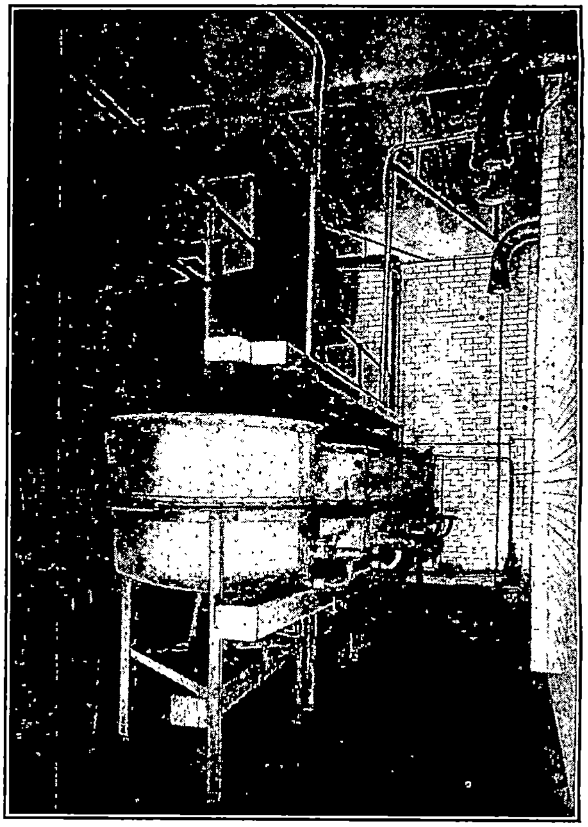


Fig. 2

FAT-CLARIFYING TANKS. FAT EXTRACTORS ON FLOOR ABOVE DISCHARGE INTO THESE TANKS THROUGH THE VERTICAL PIPES.

The fat extraction is usually effected at the conclusion of the drying process by subjecting the hot greasy product from the dryer to pressure. The machine employed is known as a Turbine Centrifugal Fat Extractor. It consists of an outer steel cylindrical case containing a rotor which is caused to revolve by a steam turbine in the base of the machine. A cylindrical perforated steel cage, fitted with a filter cloth, is loaded with the material to be fat extracted and then lowered into the rotor by a hoist. The lid of the machine is closed and steam turned on, which causes the rotor to revolve. The steel cage and its contents are thus caused to revolve at 650 r.p.m., and this revolution gives rise to centrifugal force which results in the contents of the cage being pressed up tightly against its side. The great pressure exerted squeezes out the fat, which passes through the filter cloth—the latter retaining the solids—and so to the fat purifying tank. This fat extraction usually takes forty minutes for a charge of 4–5 cwt. of material, and properly effected will leave only some 10 per cent fat in the finished product. After fat extraction the machine is stopped, the cage removed and its fat-extracted contents tipped out. This product is cooled and then ground down through a disintegrator into a uniform finely divided meal, in which form it is bagged and sold. The fat recovered passes by pipe-line from the extractor to a fat purifying tank which is fitted with a steam coil. Here water is added and brought to the boiling point by the steam coil, whilst the fat is agitated. After this washing, the contents of the warm tank are allowed to settle. The impurities sink to the bottom and are finally run off with the wash water, after which the fat is barrelled ready for sale (Fig. 2).

Briefly, therefore, the procedure is to charge a dryer with the appropriate quantity of raw material. The machine is closed, steam turned into the jacket and the agitator set in motion. After 5–6 hours the machine is stopped and its contents discharged. If oil extraction is to be undertaken, they are discharged into a suitable tank from which the fat extractor cage is filled. The latter is placed in the fat extractor and set in revolution and subjected to centrifugal pressure for forty minutes. The machine is stopped, the cage removed, and its contents discharged; they are then cooled, ground down and bagged. The extracted oil is clarified and barrelled, as already described.

In the confines of this brief article no more than an outline of the process can be attempted. In passing, however, mention should certainly be made of a rather more elaborate dryer, known as the Iwel Laabs, which is a machine possessing certain advantages not the least of which is that it definitely secures complete sterilization of the product, whilst its operation is but little less simple than its prototype described above.

CONTROL OF FOUL VAPOURS

It is obvious from the very fact that the raw material is 'waste' that much of it will be in a more or less decomposed state, and the vaporous products of this decomposition can be decidedly unpleasant. During the drying operation these vapours are driven off with the water vapour, and unless precautions are taken an atmospheric nuisance will arise. Fortunately the bulk of these vapours are soluble in water, so that the vapours emitted from the dryer are passed into a condenser where they meet a spray of water which affects their solution, and this is run off to the sewer. The uncondensable portion of the vapours will, however, pass out of the condenser, and these vapours must be carried to some point and destroyed. This can be effected by passing them into a region where a continuous and uniform temperature of 1400°–1500° F. can be maintained.

But the more effective modern method is to subject these uncondensable vapours to the action of chlorine, whereby they are completely oxidized and rendered odourless. The apparatus to effect this desirable metamorphosis is cheap initially and in upkeep, and low on its operation charges. The chlorine is purchased as a liquid gas in cylinders and connected to suitable apparatus known as a Chloronome, which measures out and applies the correct dosage of chlorine to the vapours being treated. As the uncondensable vapours leave the condenser the correct dose of chlorine is injected into the pipe conveying them, and means adopted for securing intimate admixture. The result may be discharged direct to atmosphere in an odourless condition. In the plant under my control, four machines simultaneously emitting their maximum quantity of vapour require only 1/10 lb. of chlorine per hour for its deodorization. The use of chlorine gas implies corrosion of the metals with which it comes in contact. Suitable precautions, such as painting all exposed surfaces with heavy coats of bitumen, must therefore be adopted.

PLANT REQUIRED

The amount of plant required is, of course, intimately related to the amount of material it is proposed to treat and the size of the machines it is convenient to purchase. Hence no advice can be given on this matter. The only guidance one can provide is that a small 7 ft. dryer, two small turbine extractors or one large one, a fat clarifying tank and a small disintegrator should be capable of treating 10 tons of raw material per week working a twelve-hour day. Complete guidance on this matter can, however, always be secured by laying the full facts before manufacturers of the plant, such as the Industrial Waste Eliminators, Ltd., of London.

I know that some authorities have been deterred from undertaking this work, due to the fact that they consider there is insufficient raw material available in their area to warrant the installation of the necessary plant. I am informed, however, that a plant laid down to treat only three tons of raw material per week is making a satisfactory return. Generally, this amount can be easily exceeded, especially if a few small neighbouring authorities co-operate in the disposal of this waste.

Power and Steam Requirements

The power and steam requirements of the plant employed are again regulated by its size and the amount of work undertaken. Obviously, however, such a plant can make very effective use of the steam produced, say at a refuse disposal works, from the burning of house refuse.

As some guidance in the matter, a moderate-sized plant would require the following power supply:

Dryers. 4–5 units per 1,000 lb. of raw material treated.

Disintegrator. About 20 units per ton per hour.

The steam consumption of the same plant would approximate to the following:

Dryers. 870 lb. per 1,000 lb. raw material treated.

Vacuum pump. 85 lb. per 1,000 lb. raw material treated.

Fat extractor. 140 lb. per 1,000 lb. raw material treated.

Fat clarification. 500 lb. per ton of fat clarified.

The adequate supply of feeding stuffs and fertilizers is rapidly becoming an increasingly important factor of our national economy and it behoves everyone in a position to do so, to examine the possibilities of what contribution can be made on the lines indicated above. Even if such raw materials as specified are unobtainable, there is still the problem of converting kitchen wastes into dried pig and poultry meals, which can be solved on similar lines and with the same plant, except that fat extraction will be unnecessary.

GEOLOGY AND EARLY MAN: I

By T. T. Paterson,

University Museum of Archæology and Ethnology, Cambridge

THE postulates summarized in this, and Part II, are the results of work on five expeditions, two to the Arctic with the Wordie Arctic Expeditions, to India and the Himalaya (Yale-Cambridge Expedition 1935), to East Africa, and to Northern Europe. I was financially assisted by Trinity College, Cambridge, the Royal Society, the Percy Sladen Fund Trustees, the Royal Geographical Society and Mr. L. C. G. Clarke, and have been in receipt of a senior studentship from the Commissioners of the 1851 Exhibition.

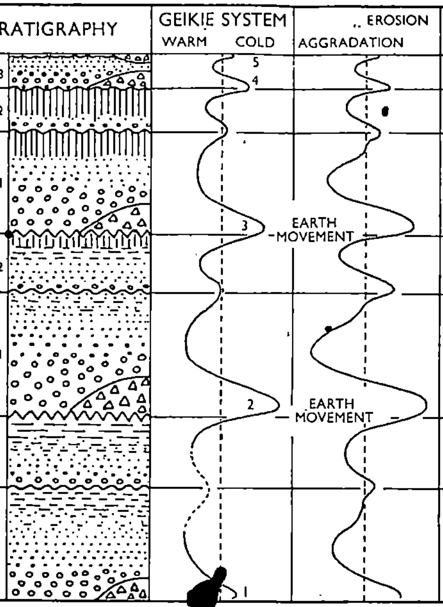
A System of Pleistocene Correlation

The correlation of the various phases of the Pleistocene throughout the world has not been in any way assisted by the obscurities attached to the interpretation of 'pluvial periods' within the non-glaciated regions. Nor has the palæontologist been able to supply enough fossils and variations of types which could give the necessary detail, one point only being of outstanding value, the palæontologist's view that the commencement of the Pleistocene is marked by the appearance of Elephas, Equus, and bison, or any one of these. This definition of Haug was adopted by James Geikie in his, the first, Pleistocene correlation system, and is followed here, as well as Geikie's simple nomenclature for glacial periods. It is deplorable that Geikie's work (which not only takes priority but also has not been seriously challenged), has been discarded in favour of a nomenclature having purely a local application to the Northern Alps. The chief sinners in this respect have been prehistorians, but lately the disease has spread among geologists and has been furthered by writings which not only show complete lack of appreciation of the works of the master but also introduce new Continental expressions into our nomenclature where plain English has well sufficed before.

A new approach is necessary, and it seems that a solution lies in the recognition of a world-wide system of three easily recognizable major cycles of sedimentation, each beginning with a coarse and ending with a fine facies. The beginning of the first seems to coincide nearly uniformly with the known earliest occurrences of the Pleistocene faunal group of Haug. These cycles are here named the Lower, Middle and Upper Pleistocene. The accompanying table illustrates the system and is self-explanatory. Each major cycle shows a subdivision into subsidiary cycles when a rejuvenation of sedimentation marks out the Lower into two phases l_1 and l_2, the Middle into m_1 and m_2, and the Upper into u_1, u_2 and u_3. Within the glaciated regions the commencements of each of the major cycles coincide with Geikie's first three cold periods, the fourth cold period marks the beginning of phase u_3, and the fifth the end of the Pleistocene.*

---

* Correction:—Gamblian (East Africa) should be age u_3, and Pagan Silt (Burma) should be age u_1.



STRATIGRAPHY		TERRACES	CHINA	JAVA	BURMA	HIMALAYA	SOUTH INDIA	SINKIANG
UPPER	U_3	T_5	Djalai Nor Panchiao	↑	T_5 T_4 gravel	T_5 5 T_4 gravel 4	T_4	
	U_2	T_4	? Mongolian sands Loess	? Solo Terraces	Pagan silt T_3 gravel	Potwar T_3 gravel	silt T_3 basal gravel	loessic loam T_3 gravel
	U_1	T_3	Loess dry Malan Chinghsui	Ngandong M	red earth dry gravel T_2	Potwar aeolian silt gravel T_2 M 3	silt gravel T_2	loess gravel T_2 M
MIDDLE	M_2	T_2	dry red loams	Trinil	dry T_1	silts T_1	little sand T_1	sand T_1
	M_1	T_1 T_D Highest Deposition Surface	Choukoutien M	Trinil Djetis M	lateritic soil T_D coarse boulder gravels M	T_D Boulder Conglomerate M 2	T_D redeposited Laterite Laterite M	sandstone Bora series conglomerate M
LOWER	L_2	●	Upper Sanmen	? Kali Glagah	Upper Irrawaddy Series	Pinjaur [Karewa]	?	Kokyar series
	L_1		[Nihowan—Yunnan] Lower Sanmen Fenho	?		Tatrot 1	?	

		VAAL BASIN	EAST AFRICA	NILE VALLEY	N. and E. GERMANY	NORTHERN ALPS	NORTHERN FRANCE	THAMES VALLEY	EAST ANGLIA	NORTH AMERICA
UPPER	U_3	dry E Schoolplaats	E gravels 30 ft. T.	E 10-15 ft. Terrace	E—T_6 Weichsel—5 E—T_5 Warthe—4	Y Loess II Wurm II—5 E Wurm I—4	Recent Loess E Solifluxions 8+9	Lower Flood Plain T_4	T_5 Gravel + Loam T_4 Upper B.C.—4	Peorian Loess Iowan—4
	U_2	dry E Youngest gravels	O—Horizon dry E "flats" gravels	30 ft. Terrace E Sediments	Loess E—T_4	Young Loess I E	"F_6" Recent Loess I E Solifluxion 7	Crayford T_3 Solifluxion	Loam—Hoxne T_3 Solifluxion	Loveland Loess
	U_1	dry Sands ● E Younger gravels III	N—Horizon dry false-bedded sands Gamblian M	50 ft. Terrace sediments E	Loess Gravels E—T_2+T_3 Saale—3	Old Loess E Old Loess—Riss—3	Old Loess E Solifluxions 5+6	Taplow T_2 main coombe rock	Loam—Hoxne Thick gravels T_2 M Middle B.C.—3	Illinoian —3
MIDDLE	M_2	Sands E Younger gravels II	dry M—Horizon ↑	100 ft. Terrace E sediments	Loess E—T_1	Loess E	"F_5" Loess E Solifluxion 4	Middle Barnfield T_1 Clacton	Unevenbedded S. Loam T_1 Solifluxion ↑	Yarmouth
	M_1	Sands E Younger gravels I	Silts Oldowan beds Sands Gravel boulder gravel M	150 ft. Terrace Depositional surface	Gravels E— Elster—2	Silts Jungerer Deckenschotter ? Mauer Intraglacial E M Mindel—2	"F_3" Gravels E Solifluxions 2+3	Lower Barnfield Gravels M	Barnham Sands T_D Thick gravels M Lower B.C.—2	Kansan —2
LOWER	L_2	dry Kalahari sands E Older gravels	Kalso		E—"Preglacial" III	Silts E	?	High Terraces and Clay-with-flints	Cromer series	Aftonian
	L_1		Kisegi	●	E—"Preglacial" IV	Alterer Deckenschotter Gunz—1	?		Crag series 1	Nebraskan —1

E = erosion. Detached Arabic numerals to right of columns represent glaciations, Geikie nomenclature. M = earth movement.

A SYSTEM OF PLEISTOCENE CORRELATION.

Within the non-glaciated regions, the beginning of each of the seven phases is marked by an erosional disconformity which, if it is thought essential, could be interpreted as evidence for a 'pluvial period'. The major periods of aggradation (see curve) follow on those erosional periods coincident with glacial advance, and end in stages of stability prior to the rejuvenations of erosion marking the next, subsidiary, phases. The first three erosional periods can only be observed as stratigraphical disconformities in section, but the last five are very widely met with as terrace escarpments. The method adopted here of defining terrace forms by the erosional scarps which isolate them has been found more satisfactory and less liable to misinterpretation than classification on terrace components which are often composite. The five terrace escarpments are named T_1 to T_5 and the top surface of deposition—aggradation gravels of m_1 succeeding the big second glaciation—T_D.

The first two cycles end with episodes of aridity which, in the tropical regions, may occupy almost the whole of the 'rejuvenation subsidiary' phases, l_2 and m_2. Dry episodes occur also at the ends of phases u_1 and u_2. In periglacial regions such arid episodes are represented by loessic deposits, in sub-tropical parts by æolian silts, and in tropical regions by bands of rock, shattered by insolation and brought to level by solifluxion during the short, but intense rainy seasons.

Under the heading 'Geikie system' the curve represents climatic change within the glaciated regions, the middle interrupted line indicating temperate climate, and curves to the left and right indicating warm and cold respectively, the depths of the glacial maxima, 1 to 5, showing ice sheet extensions rather than actual climatic extremes, for the fourth ice advance was the coldest. The repetitive cyclic character of the curves of climatic change and sedimentation variation will be seen to correspond. So it seems that the greatest ice extension and locking-up of water coincided with the greatest erosional activity in most parts of the Old World, that is, with increase in precipitation there. Therefore the factor of eustatic variation must be taken into account as important when considering the relations of base level change and isostatic compensation for ice load. The question of precipitational change will be looked into in the next section.

One further point emerges. At the beginning of both the Middle and Upper Pleistocene, there was earth movement of some kind in all except the most stable crustal blocks. In an orogenic region there may have been even over-folding and thrusting as well as uplift. For example, in the foothills of the Himalaya the Lower Pleistocene (Upper Siwaliks) were thrusted, and uplift of 6,000 ft. has taken place since the beginning of Middle Pleistocene times. At the opening of the Upper Pleistocene there was no folding, but warping began and has gone on even to the present day. In a region of rifting, faulting occurred accompanied by volcanic activity, as for example in the Rift Valley in East Africa. In the stable areas of South India and South Africa there is little evidence for earth movement, but in the Scandinavian and Canadian shield areas there are indications of vertical crustal deformation. In south Britain this was of the order of several hundred feet where, also, the London Basin was further warped on its northern flank. In the eastern Asiatic periphery and in the Rift Valley the tectonic activity of the beginning of Middle Pleistocene times extended the erosional disconformity into unconformity.

The faunal variations cannot be given here owing to lack of space, but in general it can be said that the Villefranchian type of assemblage is confined to the Lower Pleistocene, with some Pliocene survivals into phase m_1 as at Mauer and in China. By phase m_2 Pliocene survivals have gone, but the characteristic Upper Pleistocene forms, as for example *Elephas primigenius* and *Bos primigenius*, have not appeared. It seems that the intensity of cold in the fourth glaciation and the aridity which preceded and succeeded it in the later parts of the Upper Pleistocene were the causes finally of the disappearance of the Pleistocene fauna.

The close relationship of human cultures to the geological sequence is described later.

CAUSE OF THE ICE AGE

The cyclical character of the glacial and sedimentary curves and their correspondence has been remarked upon. It seems, therefore, that all over the world there has been a coincident series of changes in precipitation. Moreover, the curves show a progressive decrease in 'swing'; that is, the cycle of change decreases in amplitude from the beginning of Middle Pleistocene times onwards. A glance at any set of terraces would be convincing enough on this point. This decrease in amplitude is essentially a curve of recovery, the first stages in the Lower Pleistocene being the shorter 'build-up' towards the maximum, and the later stages the longer recovery. Obviously the catastrophe from which recovery has taken place must have occurred in Tertiary times.

In the north, in Scotland, Scandinavia, Greenland and Arctic Canada, a consistent set of physiographical features can be seen. A high-level plateau surface of mature form is surmounted by monadnocks which have undergone the effects of extreme frost-shattering and are now sharply

'Alpine' in appearance. Cut out of this old land surface are deep steep-walled canyons and fjords, which follow lines of weakness determined by major joint planes, and often, therefore, show a cruciform appearance. In both Baffin Land and Norway the fjords obviously constitute entrenched drainage systems cutting through ranges of uplifted mountains, for example, the Sogne Fjord. The matured plateau form slopes away on either side of this backbone, hence the fjord system has cut back and captured on the inner side of the range. This is well shown by the run of obsequent forms near the head waters of some of the main fjords which have so cut back. Where the system is merely entrenched into the older plateau form, which is the most common type in Norway, the heads of the fjords are very steeply graded. Further signs of rapidity of entrenchment is the presence of dry valleys—steep-walled, fjord-like in character—which have been partly cut during first stages of erosion, and left dry when the eroding stream was diverted by capture into the deeper main fjords. This is a well-marked phenomenon in eastern Baffin Land and also occurs, though sparsely, all over western Norway and in Scotland too.

That these fjords were due to the action of fluviatile, sub-aerial, erosion is demonstrated not only by the above evidence but also by V-shaped forms of the wider valleys, truncated spurs and, quite often, the serial right-angled bends in the courses of the fjords due to the intersection of major joint structures. The erosive power of ice in such valleys must have been greatly reduced. The V-shaped forms nevertheless show oversteepening due to glacial action. The valley sides in the upper parts of the fjords have composite profiles, for erosion during interglacial periods was apparently as strenuous (measured in depth) as that during glacial, and the result is a succession of V- interrupted by U-forms.

Corresponding to these older glaciated profiles are a series of three cirque types—old, mature, and young—which seem to correspond to the first two, the third, and the fourth glacial stages respectively. The terraces within the fjords are associated with the third, fourth and fifth glacial advances (and their substages) and with post-Pleistocene oscillations. The old cirques in the main fjords come well down to present sea-level, and are occasionally even drowned. The skjaergard is cut out of it and itself glaciated, and is thus Middle Pleistocene in age. Finally, the fjords are cut out of Tertiary rocks in Greenland and Canada; therefore the fjords must be, at the oldest, of late Tertiary age.

As a whole the evidence shows that during the latter period there was widespread uplift, in places over 4,000 feet, of a block comprising the Scandinavian Shield, Greenland and the northern part of the Canadian Shield, the result of the great Tertiary tectonic activity. Simultaneously, the poles shifted. The North Pole, in early Tertiary times situated in the north Pacific, moved towards its present position; that is, the poles became coincident with the newly uplifted block in the north, and the antarctic continent in the south.

Furthermore, it seems that precipitation increased, for it is unlikely that the rivers which established the mature Tertiary landscape would have been able to erode the incised fjord system. To account for this increase of precipitation, it is suggested empirically that polar shift and crustal deformation led to such a variation in geography that the precipitational norm had to be adjusted. The matter still awaits mathematical treatment. Given these conditions, it will be seen that the explanation of glacial and interglacial periods can be achieved by application either of Simpson's theory or of Croll's radiation curve. On broad grounds it appears to me that Simpson's theory fits the facts on a wide basis, accounting for the precipitational changes in other parts as well as glaciated regions.

After uplift, recovery: the land subsided and the fjord systems were drowned. The deep valleys incised into the continental shelf during the period of exposure were drowned and became submarine canyons. Later, ice sheets filled these canyons near the ice peripheries with detritus. Decreasing compensatory oscillations proceeded well into the Pleistocene and were materially affected by secondary factors such as ice load. As glaciation lagged behind uplift, so the glacial and sedimentary curves of recovery lagged behind the curve of isostatic recovery. The coincidence of crustal deformations over wide areas is significant, and one suggestion may be hazarded here. The last expedition led by Col. Seymour Sewell to the Indian Ocean demonstrated the existence of a submerged rift feature the mirror image of the African Rift Valley. The major part of the rifting occurred in late Tertiary times, that is, when uplift occurred in the northern hemisphere. (Somewhat similar uplift occurred in the south, as witnessed by the physiography of New Zealand and South America.) Bullard has demonstrated that the rifting is due to pressure, not tension. The two regional adjustments may be intimately related, for crustal pull at the poles will produce longitudinal shrinking and therefore pressure at the equator. This same shrinking may take the form of crustal drift (and hence orogenic movement) in a direction at right angles to the shrinking. Thus would occur mountain-building movements in an east–west direction, the Himalaya, the Caucasus, the Alps.

(To be continued)

M. V. LOMONOSOV (1711-1765)*

By Prof. J. D. Bernal, F.R.S.

THERE are few names in the history of science that have been more strangely passed over than that of Mikhail Vasilyevich Lomonosov. Because his life was spent for the most part beyond the confines of the scientific world of the eighteenth century, his ideas and his influence never made themselves felt outside Russia, but there he is revered as the real founder of Russian science with as just a title as Liebniz in Germany, or Franklin in the United States.

No one could have excelled him in his determination to pursue and develop science. He was born the son of a poor fisherman on a remote island on the fringe of the Arctic Circle. Although Russia was then, apart from the newly formed capital of Peter the Great, sunk in complete barbarism and ignorance, he forced his way to knowledge. At the age of nineteen he went to Moscow, where, passing as a priest's son, he managed to enter a monastery school which could teach him little but Latin and church Slavonic. Three years later he was called among the most gifted pupils to the newly formed Academy at St. Petersburg, at this time an entirely foreign creation. The Government wanted to train native Russians in prospecting the great mineral resources of the country and in setting up new industries. Lomonosov was one of three who were sent abroad for this purpose. He studied mining at Freiburg, and general science under the great Christian Wolff at Marburg. There at last he came into contact with the full stream of eighteenth century scientific enlightenment, and when he went back to Russia four years later he was able far more effectively than his foreign colleagues to introduce that spirit into his country.

It would have been remarkable enough if Lomonosov had acted as an apostle of scientific culture in Russia, but he was far more than that. Brought up out of contact with the whole tradition of the West, he was, after a few years' study, able to grasp it and in a large measure to transcend it. Possibly because of his very freedom from preconceived ideas, his work shows him to have possessed a clear comprehension of physical and chemical principles a century before they won general recognition. Lomonosov's writings are few, and mostly buried in the archives of the St. Petersburg Academy, but each one of them is an expression in the most orderly and clear way of some fundamental principle in physics or chemistry.

In a century when chemical theory was deeply buried in confused mysticism, Lomonosov introduced clear and precise terms. In his "Elements of Mathematical Chemistry" in 1741, he gives definitions of elements, compounds and molecules which would pass muster to-day. Even more surprising was his description of the structure of solids, liquids and gases, and his first statement of the mechanical theory of heat and the kinetic theory of gases, leading him, in particular, to postulate the existence of an absolute zero. His analytical mind refused to deal with such concepts as phlogiston or fiery principles; to him the increase in weight of metals on calcination was due to the combination of atoms from the air which could be expelled on further heating. But lacking the devices of pneumatic chemistry, he was unable to anticipate the discoveries of Priestley.

In physics, Lomonosov's chief contribution was to meteorology (where he devised an anemometer) and atmospheric electricity. His colleague Richter was the first victim to the study of lightning that Franklin had started. Lomonosov speculated acutely on the causes of the aurora and the importance of cold fronts in weather changes. Perhaps more remarkable than any individual achievement is the way in which Lomonosov understood the nature of systematic scientific inquiry. This is shown very clearly in his lectures on "Real Physical Chemistry" in 1752. He is particularly insistent on the need for quantitative methods in chemistry, and for the measurement of all physical properties connected with chemical reactions. Of the relations between physics and chemistry he wrote: "A physicist without mathematics is blind, without chemistry he is paralysed". His understanding is shown best by his research programmes, which he initiated and carried out in the new University of Moscow, of which he was the founder and first principal. Unfortunately the note-books containing his results have been lost, but the programme of the work shows its comprehensiveness. On the solution of salts, for example, he proposes to measure:

(1) The solubility of all principal salts at different temperatures.
(2) Density of different solutions.
(3) The change in volume on solution.

---

* Substance of a lecture delivered on June 28, under the auspices of the Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R.

(4) Change in temperature on solution.
(5) Variation of the density with temperature, to the freezing point.
(6) Effect of solution on the boiling point.
(7) Specific heat of the solution.
(8) Mutual effect of different salts on each other's solubility.
(9) Rate of freezing.
(10) Effect of dissolved air.
(11) Whether solutions self-cooled regain heat as rapidly as those cooled externally.
(12) Effect on cohesion.
(13) Refractive indexes of solutions.
(14) Capillary constants of solutions.
(15) Microscopic examination.
(16) Effects of pressure in a Papin's digestor.
(17) Effect of an electric field.
(18) The colour of electric sparks and arcs in solutions.
(19) Comparison of solutions in vacuum and in air.

We are still trying to complete the programme he here sets out, but its recitation is enough to show what an extremely modern view he held in physical chemistry.

The distinctive character of Lomonosov's work was that he combined the mathematical inheritance of the Newtonian era, which he no doubt derived in the first place from his master and friend Euler, with an extremely lively and detailed interest in the actual phenomena of Nature and in the practices of the arts. We can recognize now a general relative decadence of science in the middle of the eighteenth century, a turn to formal mathematics and experimental dilettantism. Lomonosov stands out against this background, and foreshadowed the great work of the period of the French Revolution. He resembled Lavoisier in his mental approach to the problems of chemistry. His curiosity, though insatiable, was ordered and practical, and he was an organizer of research as much as a thinker.

Here we have a scientist of the first rank, but Lomonosov was a great deal more than that. His most important immediate influence was in quite a different sphere, that of philology and poetry. He is still revered as the first native Russian poet, and Pushkin repeatedly acknowledged his debt to him. He wrote the first Russian grammar as well as the first modern Russian history. All through his life he struggled against the cramping influence of the traditional and clerical obscurantism of old Russia and the trivial and pedantic atmosphere of the Court and the Academy. Unlike many more famous men he was never deceived by the flattery of the great, but worked steadily for the education of the Russian people.

How was it that with all his ability and achievement his work seems to have had so little immediate consequence in the world of science ? Partly no doubt because of the distance of Russia and the degree to which it was cut off from the active world of English, Dutch and French science ; partly because of the jealousies and vested interests of the foreign academicians ; but most of all it was due to the backwardness of life in Russia, of which Lomonosov himself was so well aware when he lamented that there was no one to understand him or to carry on his work. But Lomonosov's work did not go unrewarded, however little immediate influence it had in the West. It was to him that the great liberating influence of scientific thought in nineteenth century Russia was largely due. But it is only in the past twenty years that Lomonosov's aspirations have been realized. The Soviet Union is now celebrating his 175th anniversary; but it is the utilization of the resources of the country and the spreading of scientific education to all that marks the real culmination of his work.

OBITUARIES

Mr. O. Gatty and Mr. A. S. Chessum

OLIVER GATTY, who died on June 5 at the early age of thirty-two from an accident when engaged on research in the service of his country, was an investigator of exceptional calibre and promise and possessed a mind of unusual capability. From Winchester he went to Balliol College, Oxford, where he obtained a 'first' in chemistry in 1930. In 1931 he was elected to a tutorial fellowship at his College. His interests, however, were in research rather than in teaching, and two years later he resigned in order to visit Rothamsted, where he became interested in the mechanism of living processes. He left Rothamsted to work with Prof. J. Gray in the Department of Zoology at Cambridge, and later joined my Laboratory.

Gatty showed that all the phenomena such as passivity and corrosion attending the immersion of metals in solutions of electrolytes could be interpreted on the basis of local action currents involving the presence of anodic and cathodic areas. It was with this background that he approached the subject of biopotentials. He quickly realized that thin layers of insoluble substances could not affect the electric potential difference between two phases in equilibria, but that they might produce profound effects if there existed a diffusion potential between the two phases. These diffusion potentials are in all probability the result of continuous enzymitic processes. The ionic permeability of the thin interphase membrane thus becomes one of the important factors in the magnitude and sign of the biopotential. Gatty carried out a series of interesting experiments on frog skin, and showed that all the bio-electric phenomena observed with this material could be accounted for if the frog skin were regarded as electrically equivalent to a resistance in series with areas permeable to anions and cations respectively. He made the further tentative suggestion that the cathodic areas might be the pores between the cells.

Gatty could dissect a complex problem into its simpler components and bring to bear on each a mind possessing the unusual faculty of not only visualizing the mechanical nature of the problem, but also of combining with this mathematical analysis.

He was a man with wide interests, attending the Ottawa Conference in 1932, and was a member of the Spitsbergen Expedition of 1933. He was likewise deeply interested in psychic phenomena. His personal charm, his humour, and his unvarying kindness and sympathy for the underdog won him many friends, both in and outside the Laboratory. Although I knew Oliver Gatty for all too short a period, he was rapidly becoming one of my closest friends.

Eric K. Rideal.

Alfred Stanley Chessum was for thirteen years a member of the workshops staff of the Engineering Laboratory of the University of Cambridge. He was an exceptionally brilliant craftsman—a man endowed with ability to think round his work and capable of producing anything within the capacity of the plant entrusted to him.

These qualities singled him out, and consequently he was chosen to build the apparatus for Mr. Gatty's experiments. Chessum's enthusiasm for this work was possibly only excelled by that of Mr. Gatty himself, and many of Chessum's ideas were incorporated in the design. He understood the urgency of this problem and worked quickly to produce the apparatus in the shortest time. The tragic circumstances which ended this series of experiments have robbed this department of a pleasant and cheerful personality, and a man whose sound common sense and outstanding qualities must be considered irreplaceable.

C. E. Inglis.

Prof. J. H. Muirhead, F.B.A.

Prof. John Henry Muirhead, who died on May 24, carried his eighty-five years so lightly, his vigour of mind was until the last so abundant and his sympathy with young life and new ideas so unfailing, that it is hard to think of him as what he was, perhaps the last surviving representative of the Idealist philosophy that had its heyday in the eighteen-eighties and nineties. But as a pupil of Edward Caird in Glasgow and of T. H. Green at Balliol, he had been in the movement from its beginning and was to watch its extending influence far beyond the ranks of academic theory, then, in the last generation, its decline before the criticisms of younger movements. If not one of the leading thinkers of the school, Muirhead was certainly one of its most successful and indefatigable teachers, both directly for more than a generation in university posts and indirectly through his wide personal contacts, through his work for the British Institute of Philosophical Studies and in many other ways, while his writings cover a period of not far short of half a century. Finally, as a foreign critic has remarked (Dr. R. Metz, "A Hundred Years of British Philosophy"), Muirhead "made a distinguished contribution to the history of the idealistic movement. Placing it in a wider intellectual setting, he has sought to understand its origin and development as well as its total significance". The reference here is especially to his book on "The Platonic Tradition in Anglo-Saxon Philosophy" (1931).

Muirhead's own special interests were mainly in the bearing of philosophy upon human life and the social sciences. His first book, "The Elements of Ethics" (1892, fourth edition 1932), has for long been widely used as a text-book; he used to enjoy telling how some years ago it was banned in Japan because of a passage misinterpreted as putting forward a defence of tyrannicide. "Philosophy and Life and other Essays" (1902), "The Service of the State" (1908), "Social Purpose" (in collaboration with Sir H. J. W. Hetherington) (1918), "The Use of Philosophy" (1928), "Rule and End in Morals" (1932) are indicative of this primary interest, as is his last published work, the Herbert Spencer Lecture delivered at the University of Oxford less than two years ago on "The Man versus the State". His little book on "German Philosophy in Relation to the War", written in 1915, was a corrective to certain war-time prejudices for which there is again a use to-day.

As general editor of the series "Library of Philosophy" over a long period of years, Muirhead not only displayed his own catholicity of sympathy and interest in thought of widely different tendencies but was also instrumental in introducing to the English reader the works of eminent foreign and American thinkers such as Bergson, Croce, Varisco, Radhakrishnan. He was also general editor of a valuable collection of personal and autobiographical statements "Contemporary British Philosophy" (1924-25). Up to the end of his life he always delighted in opportunities to hear from practising men of science in chemistry or physics or biology to what tentative general conclusions, if any, their researches were leading them. He was a great appreciator and conciliator, and many workers in more specialized fields must feel grateful to him for his breadth of outlook and his unshaken faith in "Man's Unconquerable Mind".

John W. Harvey.

We regret to announce the following deaths:

Major P. H. G. Powell-Cotton, founder of the Powell-Cotton Museum of big game at Birchington, on June 26, aged seventy-three.

Sir Raymond Unwin, an authority on town planning, aged seventy-six.

NEWS AND VIEWS

Wildlife in the Channel Islands

THE German occupation of the Channel Islands interrupts a good number of years of continuous, sound biological field work conducted by the Jersey Branch of the British Empire Naturalists' Association amongst a fauna and flora unique in the British Isles for representing the northern limits of many Mediterranean species. Its air fauna has been shown to be rich in nesting species like peregrine, puffin, raven, guillemot, razorbill, oyster-catcher and various gulls, while the flora includes the first European station for the American club-rush (*Scirpus americanus*), which was probably introduced to St. Ouen's pond by wildfowl, the only British station for the Jersey bugloss, and also the yellow broomrape. There are also such interesting plants as sea-scabious, spotted rock rose, the beautiful hyssop-leaved loosestrife, clustered trefoil, four-leaved alseed, evergreen alkanet, spreading star-thistle, five-spotted catchfly, French pink and proliferous pink growing about the quarries, the cliffs, or the shore.

The Rev. P. Burdos and Mr. H. J. Baal have for some years made a study of the bird life of the islands, and Mr. E. R. Casimir has recorded much of the flora. In winter the islands are so mild that at Christmas it is the normal thing to find some forty species of plants in flower. A great deal of low-tide research has been carried out at L'Etacq under the supervision of Mr. Baal and others, and the marine specimens exhibited at the States of Jersey Library; butterflies on the Queenevais were also watched and recorded, especially in relation to the migrations from France to Britain. Special efforts were made to conserve the wild life in the pretty Belle Hougue valley. Recorders have long debated whether records from the Channel Islands (and from the Scilly Isles) should not be credited to the British list, but to the French lists. The geology is mostly French, although where the granite predominates the scenery resembles Devon and Cornwall.

Purchase Tax on Books

MR. KENNETH LINDSAY asked the Chancellor of the Exchequer in the House of Commons on July 2 whether he would exclude the book trade from the Purchase Tax, in view of the dependence of book exports on the volume of home trade and the vital importance of the book industry to the moral of English-speaking peoples, but Sir Kingsley Wood said that he had given careful and sympathetic consideration of the matter, and regretted that he could not exempt the publishing trade from making this contribution to the revenue needed for the prosecution of the war. It is legitimate comment on this reply to point out that while the tax is collected from the publishing trade, the cost of the tax must fall on the public. As we have already pointed out (NATURE, May 11, p. 719), it is against the public interest both from the financial and the intellectual point of view to place a check on the sale of literature, a substantial proportion of which represents export business. The position is totally different from that in many other industries, where export trade does not depend on sales in Great Britain, and where it is desired for various reasons to reduce consumption at home. It is to be hoped that the Government may yet find a way of relieving the industry of the proposed burden.

Shortage of Ergot

AN open request has been made to medical practitioners by the War-time Requirements Committee appointed by the Medical Research Council to observe strict economy in prescribing ergot. This is one of a remarkably small number of important drugs which have become scarce since the War began. The primary reason for the scarcity is not the present War so much as the Spanish Civil War, for Spain has not recovered her trade in this valuable item of *materia medica*, which was neglected during the period of domestic strife. Other countries which supplied substantial quantities of ergot were the U.S.S.R., Poland and particularly Portugal. Supplies of Russian material available to other countries have been steadily diminishing for the past two years, because the bulk of the output is reserved for use in Russia itself. The cessation of Polish supplies was, of course, a direct consequence of the War. In the last two years, the crops of Portuguese ergot have been below normal; indeed it is said that the last crop was a failure. Thus the world outside Germany and certain mid-European countries where sufficient quantities of the drug are produced for domestic requirements has had to depend mainly upon the diminished output of Portugal. Very large quantities of ergot, which is a fungus parasitic on the rye plant, are prescribed in general midwifery practice and in maternity hospitals, but it appears to be the view of the Medical Research Council that the prescription of ergot could be greatly reduced without prejudice to patients.

Royal Aeronautical Society: New President

MR. GRIFFITH BREWER, who is an honorary fellow of the Royal Aeronautical Society, has been elected president of the Society for the year 1940–41. Mr. Griffith Brewer was born in London in 1867 and commenced ballooning so long ago as 1891. When Wilbur Wright went to France in 1908, Mr. Brewer was his first English passenger. From then on he devoted his attention to aeroplanes and in 1914 learnt to fly at the Wright Field at Dayton, Ohio. During the War of 1914–18 he was honorary adviser to the Airship and Kite Balloon Services at Roehampton from 1915 onwards, and made experiments with ripping kite balloons in the air after breaking of the cable for the R.N.A.S. during 1917–18. In 1912 he founded the Wilbur Wright Memorial Lecture. More recently he has delivered addresses at Dearborn (1938) and at Massachusetts Institute of Technology (1938) on the Wright Brothers' scientific research. It was largely due to Mr. Brewer's efforts that Mr. Orville Wright has lent his original aeroplane, on which the first power flights were made at Kitty Hawk, North Carolina, to the Science Museum, South Kensington, where it has been for the past twelve years.

Philip Syng Physick (1768-1837)

IN an address recently delivered before the Royal Society of Medicine (*Proc. Roy. Soc. Med.*, 33, 145; 1940) Dr. George Edwards gives an interesting account of Philip Syng Physick, "the father of American surgery". He was born on July 7, 1768, at Philadelphia, where he graduated in the Faculty of Arts at the age of seventeen. In 1788 his father, who was receiver-general of the Colony of Philadelphia, took him to London, where he became a student at St. George's Hospital and served first as a dresser and then as house surgeon to John Hunter. In 1790 he received the diploma of the Royal College of Surgeons. In the following year he went to Edinburgh, where he obtained his doctorate with a thesis on apoplexy, which he dedicated to John Hunter. In 1792 he returned to Philadelphia, and two years later was appointed to the staff of the Pennsylvania Hospital and that of the Philadelphia Dispensary. He rapidly gained an extensive practice owing to his surgical skill, particularly in two operations, namely, enucleation of the lens, and removal of stones from the bladder. He devised several new operative methods and surgical instruments, including improved treatment of chronic ulcers, fractures and dislocations, the invention of a tonsillotome and of a forceps for controlling hæmorrhage, and various modifications of catheters.

In 1800 Physick was appointed professor of surgery at Philadelphia, and held this post until 1819, when he succeeded his nephew, John Syng Dorsey, in the chair of anatomy. He retired in 1831 at the age of sixty-three, and was unanimously elected emeritus professor of surgery and anatomy "as a tribute to his merit in elevating the character of the school and in promoting the advance of medical science". He received many honours at home and abroad. From 1824 until his death thirteen years later he was president of the Philadelphia Medical Society; in 1825 he was the first American to be elected a member of the French Royal Academy of Medicine, and in 1836 he became an honorary fellow of the Royal Medical and Chirurgical Society of London, the predecessor of the Royal Society of Medicine. He left no writings of importance, but his methods and teaching are embodied in Dorsey's "Elements of Surgery" (1813), which went through three editions, and Gibson's "Institutes of Surgery" (1824). He died on December 15, 1837.

Hagiological Healing

THE April issue of the *Bulletin of the History of Medicine* contains a richly documented article by C. Grant Loomis of Harvard University summarizing some of the aspects of miraculous healing which will be of interest to the anthropologist and folklorist as well as to the medical historian. While most of the miracles on record appear to have been accomplished solely by prayer and sincere belief in the efficacy and intercession of holy men, additional factors in a number of cases have been superadded to the simple act of faith. In some conditions, for example, such as deafness, paralysis, headache, poisoning, blindness and severed members, the efficacy of saliva has been reported (see NATURE, April 13, 1940, p. 585). The external or internal use of water in which the saint has washed himself has been employed for numerous complaints, especially blindness, fever and insanity. Other fluids such as blood from a holy corpse, sacred oil from various sources, milk from the mothers of saints and wine from the chalice or hand of a saint have also been credited with curative properties. In many instances, sacred dust, earth or mud from the houses or burial places of saints have served as the chief element in cures, while grass and flowers from their tombs have sometimes proved beneficial. Relics of all kinds have been used for various ills not only in individuals but also in the control of epidemics. All the major saints and some of the minor ones have been credited with miraculous healing power, but it was exceptional for them to have employed popular remedies.

Jewish-Christian Intermarriages in Budapest

IT has become a commonplace of sociological and economic argument that the rapid increase in facilities of transport and inter-communication between peoples geographically remote from one another has made the world 'a small place'. Evidently it has a profound biological effect upon humankind in the aggregate, diminishing steadily by interbreeding the innate biological differences that formerly existed between races and other differentiated groups of human beings. Prof. Raymond Pearl, when discussing a few years ago the future of war as a phenomenon and a social agent, stressed this tendency to uniformity in human beings as well as its effect in the slow and steady weakening of the religious and social taboos which inhibit mixed marriages. While there is general agreement that interbreeding is taking place at an accelerated pace at the present time, there is very little in the way of precise statistical observation by which this conclusion can be proved and quantified.

Valuable material pertinent to the issue has been drawn by Prof. Pearl from successive volumes of [illegible] municipal archives of Budapest, covering the period 1897–1935. From the marriages recorded in this period, of which Prof. Pearl has plotted the figures to show the trend of Christian, Jewish, and mixed marriages (*Bull. Hist. Med.*, 8, 3; 1940), it would appear that the proportion of Jewish and Christian marriages to all marriages of either Christian or Jews increased generally throughout the period and to a marked degree, being 2·6 per cent greater to all Christian marriages in 1935 than in 1897, while it was 3·05 per cent greater to all Jewish marriages in the same year. Since 1925, however, the proportion of mixed Jewish and Christian marriages to all Jewish marriages has slightly increased, whereas the proportion to all Christian marriages has declined slightly. This is attributable to a decline in the Jewish population and an increase in the Christian after 1919. There is a further tendency to be noted in the fact that a greater number of Christian brides marry Jewish men than of Jewish brides who marry Christian men. Here again there is a marked increase in the differential between the two types in the post-War years.

New World Origins

For long the amazing efflorescence of indigenous culture among the Mayas and Aztec of Central America was the only aspect of American archæology to attract the serious interests of European students. Even the intensely absorbing question of the origin, character and chronology of such alleged early skeletal remains, germane as it was to the inquiries of human palæontology and ethnic origins in the Old World, received less attention than it deserved. Extravagant claims for the antiquity of man on the American continent, readily demolished in most instances, were no doubt responsible for something more than a certain reserve in the approach to the general question. All this has to a great degree been changed, and the discovery of the Folsom point in New Mexico and other regions of the south-western United States in clear association with an extinct fauna has now placed the discussion of the antiquity of man in America and the early cultural history of the continent on a basis which enables British archæologists to enter upon the discussion of a problem conditioned by data of which they have a ready understanding and with which it may be said they have at present a closer acquaintance than their American colleagues. This is implicitly admitted by Prof. E. B. Renaud, one of the pioneers in the study of Folsom man, in his most recent published work.

The literature of Folsom man is already large ; but to those who have not been able to follow it closely, we may commend an excellent critical analysis which is part of a discussion of the whole question of New World origins appearing in *Antiquity* of June, by Dr. J. Grahame D. Clark, whose experience of analogous European stone age cultures carries great weight. His typological argument on the much debated question of the relation of the Folsom point and the more generalized Yuma point therefore deserve careful attention, although the recently discovered northward extension of the Folsom point so far as Canada may be found to have greater significance than as yet has been attached to it.

"Elephants and Ethnologists"

An echo of the famous "Elephants and Ethnologists" controversy appears in a contribution by Mr. W. Balfour Gourlay in *Man* of June 1940. This controversy, it will be remembered, turned on the alleged occurrence of representations of the elephant in the Mayan sculptures of Central America, which were held to demonstrate the Asiatic derivation of Central American culture, while others held, as it has been put, that the elephants had trampled finally on the theories of the Diffusionist School of Elliot Smith, Perry and their followers. Mr. Gourlay refers in the first place to a discovery brought to his notice at Guadalajara, Jalisco, in Mexico. Here it was stated human and elephant bones had been found in association. He did not see the find *in situ*, but his subsequent inquiries leave no doubt that the position of the human bones was due to burial.

A more intriguing evidence was observed by Mr. Gourlay in 1921. It left him in little doubt that man had lived in Central America in contemporary association with some elephant-like creature. This was a primitive and almost life-sized representation of the head of a strange animal carved from a block of black lava which then stood on a pedestal outside the museum at San Salvador. The statue, of which two photographs are shown, was about two feet high. The animal bore a trunk, too long for that of a tapir, too short for an elephant. If it was intended to represent an elephant, the artist evidently had never seen one, and did not understand its anatomy, as the eyes were placed in the middle of the ear-lobes. Sir Grafton Elliot Smith, to whom the photographs were shown, was convinced that an elephant was intended, much copying being responsible for the departure from realism ; but the author is not convinced and regards it as a problem demanding solution.

R 276

Attracting Birds

In earlier less sophisticated days the desirability of attracting birds was accepted without question. Now doubts have arisen, partly because it is recognized that some birds may do some harm to man's possessions, and partly because the congregating of birds at a common feeding ground may lead to the spread of diseases among the birds themselves. These dangers are recognized and provided for in a new pamphlet, the first of a series of Conservation Bulletins, issued by the Bureau of Biological Survey of the U.S. Department of the Interior. In it W. L. McAtee summarizes clearly and with line illustrations suitable methods of encouraging nesting, and discusses the proper foods to be supplied to a number of the commoner birds of the States. His hints apply equally well to many British birds, and particularly useful will be found a short section dealing with common cultivated annual plants which may be sown for the encouragement of seed-eaters such as siskins, gold-finches and other finches. For fruit-eating birds there is a short list of shrubs and trees the fruits of which persist into the winter, when the birds have most need of them. It is a useful list for anyone wishing to create a shrubbery likely to be appreciated by winter bird visitors.

Significance of Television

An instructive address on television given at Buenos Aires last year by Mr. W. E. Tremain, chairman of the Argentine Centre of the Institution of Electrical Engineers, is published in the May issue of the *Journal of the Institution of Electrical Engineers*.

Mr. Tremain begins by saying that the more we study recent developments in television, the more we are forced to realize that high-definition television is one of the outstanding scientific and engineering achievements of our time. In August 1936, the Alexandra Palace transmitter in north London was in full operation, giving the first public television service in the world. On May 12, 1937, the Coronation procession was televized with much success. It was the first outside television exhibition of importance. In conclusion, Mr. Tremain points out that television is destined to play in the future a leading part both as a means of communication and as a means of instruction. When planning for the future, it is important to bear this in mind. In England, as a result of pressure both from the cinema and radio industries, the experimental work being conducted for the purpose of extending the television service in the provinces was expedited. If a definite decision be taken with this end in view, we can look forward hopefully to it giving much direct employment in happier times.

Standardizing Electric Distribution Cables

MR. S. W. MELSOM, of the staff of the Cable Makers' Association, has contributed a paper on the standardization of cables and equipment, with the object of reducing distribution costs, to the *Electrical Review* of June 7. Discussions have been going on for several years in order to frame an acceptable set of rules. The outbreak of war prevented the embodiment in the revised British Standard Specification for mains cables of the discussions during the last two or three years. The selection of standard sizes for cables to be used in a low-voltage network is a matter almost entirely for the supply engineers. It is difficult to forecast accurately the load which a distributor will have to carry, and since the data on which estimation has to be based are somewhat nebulous, there are strong reasons for the adoption of a few—possibly not more than two—standard sizes for a given system of low-voltage four-core cables.

Since the size of the undertaking and the load-density in the cable must vary between districts, it has been suggested that three sizes of four-core cable are required, namely, 0·1, 0·2 and 0·3 sq. in., the smaller sizes being sufficient for the smaller systems and the larger for larger systems. Some suggest also that it would be more economical to use shaped and not circular conductors. The initial difficulties experienced in the construction of this type of cable have been overcome by the use of special apparatus. It is believed that the shaped conductor is quite as satisfactory as a circular conductor and is better technically. Difficulties have been experienced as to the best colours to use to identify the cores. The proposals that have been put forward envisage leaving the colours to the switchboard manufacturers and using numbers for the identification of cable cores. The questions of factor of safety and cost, now nearing solution, have involved a very large amount of work on the part of designers, research laboratories and testing authorities and great improvements are in immediate prospect.

An Automatic Distress Signal

THE Ministry of Shipping has given its approval to the 'Raft-o-Lite' safety flashing light of the International Marine Radio Co., Ltd., 63 Aldwych, W.C.2. It comprises a battery and light in a water-tight case, provided with a float so that it will assume a vertical position when floating in the sea. A flasher is incorporated with it and this is designed to emit automatically the international distress signal 'S.O.S.'. When stored in an inverted or horizontal position the light is not in use, but when thrown into the water it assumes a vertical position and the flashing light is automatically switched on, continuing for forty-eight hours at least. The manufacturers point out that these lights are particularly suitable for oil-burning ships and tankers, where oil on the water may render dangerous the use of open flares.

Breeding of Herbage Plants in Scandinavia and Finland

JOINT PUBLICATION No. 3, "The Breeding of Herbage Plants in Scandinavia and Finland" of the Imperial Agricultural Bureaux of Aberystwyth and Cambridge contains considerable information on the breeding of clovers and pasture grasses in Norway, Sweden, Denmark and Finland. The contributors are S. Nilsson-Leissner, F. Nilsson, E. Åkerberg, R. Torssell, H. N. Frandsen, H. Wexelsen, and O. Pokjakalliv. A significant feature of the work in these countries is that the breeding work on a given crop has led to the country becoming independent of foreign seed for that crop. It was found, for example, that selection of late strains of red clover from local strains improved the yield by 10 per cent, and such selections are now so popular in Denmark that it is unnecessary to import seed. Similar results are reported from Norway and Sweden, where resistance to *Sclerotinia trifoliorum* and Tylenchus, 'persistance' and winter hardiness are of particular importance.

Both in red clover and timothy grass, inbreeding has been found to lead to drop in yield, vigour and fertility, while the 'hybrid corn method' of crossing inbred lines to produce heterosis is scarcely practicable. It is found preferable to adopt plant selection and cross breeding to give natural selection full scope. Frost hardiness is selected for by removing the snow from timothy plants. Alsike and white clover together with various species of Lolium, Festuca, Poa, Agrostis, Dactylis, Bromus and other genera are being bred for commercial work. The more important varieties which have been raised and a list of the many plant-breeding stations in Scandinavia which are given in this useful publication indicate the extent of the work in progress.

Map of Antarctica

THE Antarctic regions have been of official interest to Australia since 1933, when the Commonwealth Government announced its claim to a large sector of the continent south of the Indian Ocean between the Ross Dependency of New Zealand and Enderby Land. The Australian Antarctic Territory embraces about one quarter of the Antarctic regions. The

Commonwealth Government has now published a two-sheet map of Antarctica by Mr. E. P. Bayliss (Department of External Affairs, Canberra. With handbook. 7*s.* 6*d.*). The map is on an azimuthal equidistant projection and has a latitudinal scale of 1 : 7,500,000. Known land, revised to the most recent discoveries, is shown in brown with valley glaciers in blue. Prominent peaks and heights in metres are shown. The ocean is blue, with soundings and bathymetrical contours. The names of the chief discoverers of lands are shown, and the territorial claims are indicated on the main map and on a smaller scale inset which shows relation with the southern continents. The recently claimed Norwegian sector is not marked as such. The coastal areas of the Australian Antarctic Territory are shown on another inset on a scale of 1 : 5,250,000. On many coasts the tendency to replace the term 'land' by 'coast' has been followed, but where no general name exists the multiplicity of 'lands' remains. The map is an excellent piece of work, with much detail, and is clearly printed. It should prove a standard map for some time. The accompanying handbook gives an account by Mr. J. S. Cumpston of recent exploratory works and cites most, but not all, of the authorities and explorers' records. It contains also an index to the map.

Pasteur Institute of India, Kasauli

It is announced in the thirty-eighth annual report of this Institute, recently issued, that the anti-rabic treatment which has been carried on here for forty years has been transferred to the Central Research Institute, Kasauli. The Kasauli Pasteur Institute was formally opened for the treatment of dog-bite and similar cases in August 1900 under Major David Semple, R.A.M.C. It was the first Pasteur Institute to be established in the British Empire; in the first year 321 persons were treated, and the numbers increased year by year until in 1938 more than 22,000 persons received treatment. During its last year, 1938, 20,377 Asiatics and 1,817 Europeans received anti-rabic treatment at Kasauli and its associated centres, with 73 deaths, a mortality of 0·33 per cent, the lowest figure during its long history.

Demography of Eire

According to the recently published returns of the March quarter, the marriages registered in Eire during this period numbered 3,509, which was equivalent to an annual rate of 4·7 per thousand of the estimated population, this rate being equal to that for the corresponding quarter of 1939. The number of births amounted to 14,110, of which 7,228 were of males and 6,882 of females. This represents a rate of 19·1 per thousand of the population, being 0·3 below the rate for the first quarter of 1939. The total included 460 illegitimate births, equivalent to 3·3 per cent of the total births recorded. The number of deaths registered during the quarter was 13,376, of which 6,887 were of males and 6,489 of females. The equivalent annual rate was 18·1 per thousand of the estimated population, being 0·1 below the rate for the first quarter of the preceding year.

Juvenile Literature

"500 Books for Children", by Nora E. Beust (Washington, D.C., 15 cents), is a pamphlet with a sound idea behind it. Capable selections from the present overgrown jungle of books are a great help, if not a necessity. The list is well arranged in three sections of advancing age and indexed with cross-references. With a host of new books, old favourites still keep their places, such as Kingsley's "Heroes", "Treasure Island", and Kipling's "Mowgli" and "Just So" stories. We looked for some time for the two immortal "Alices" and at last found them under C. L. Dodgson, who never would admit that he wrote them. Animals, flowers and Nature in general are well represented. Children can even get an idea of what happens inside the atom. The illustrations show two designs which have won special medals.

Announcements

General de Gaulle, leader of the French Volunteer Legion, has appointed M. André Labarthe director-general of all French services connected with armaments and scientific research in Great Britain. M. Labarthe, who is thirty-eight years of age, has appealed to French engineers, men of science, and industrial workers to join the already large number of their colleagues who have enlisted as civilian workers in the Legion.

The Minister of Labour and National Service has appointed Sir William Beveridge, master of University College, Oxford, and formerly director of the London School of Economics and Political Science, as commissioner to survey the available resources of man-power of all kinds and to report thereon with suggestions on the means by which these resources can be utilized fully for national purposes. The office of the survey will be at the Ministry of Labour and National Service, Montagu House, S.W.1, and Mr. A. Reeder, deputy director of statistics in the Ministry, will act as secretary to the survey.

The Summer School in Social Biology arranged by the Educational Advisory Board of the British Social Hygiene Council, which was to have taken place at Westminster College, Cambridge, during August 1–8, has been postponed until the advent of more favourable circumstances.

Dr. Charles Slater, consulting bacteriologist to St. George's Hospital, London, who died on March 15, bequeathed £10,000 to St. George's Hospital for teaching bacteriology or research work in that science, £5,000 to the University of Manchester for the equipment and maintenance of the laboratories, and £4,000 to the University of Cambridge for teaching or research work in medical science.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Fission Products of Uranium produced by Fast Neutrons

IN continuation of our experiments on the fission of uranium by fast neutrons, we have been studying decay periods of various isotopes. In this communication we give the results on silver and cadmium isotopes.

The uranium oxide, U_3O_8, carefully purified and freed from its disintegration products just before the experiments, was exposed to fast neutrons produced by bombarding lithium with 3 Mev. deuterons of several microamperes from our cyclotron, as described in our earlier note[1]. The exposure ranged from a few hours to some fifty hours, according to the object of the experiments. From the irradiated sample, silver was separated as iodide or chloride, cadmium as sulphide. Each fraction, carefully freed from the known fission products of uranium such as barium, lanthanum, antimony, tellurium, iodine, molybdenum, etc., was examined for its activity.

The decay curves of the silver fraction, which were obtained from samples exposed for some fifty hours, showed two periods, 7·5 days and 3 hours. The former activity is probably identified with ^{111}Ag [2,3] and the latter with ^{112}Ag [3].

The decay curves of the cadmium fraction, which was obtained from long exposures, showed apparently three periods, fifty minutes, several hours and 2·5 days. The first activity is possibly an isotope reported by Dodé and Pontecorvo[4]. The second one was proved to be ^{117}Cd by the identification of indium activity produced through its series transformation in the following way. Cadmium sulphide from a sample irradiated for 3 hours was dissolved in hydrochloric acid three hours after the initial separation of cadmium. The solution, after an addition of indium nitrate, was treated with an excess of ammonia. The precipitated indium hydroxide was filtered off and examined for the activity. Its half-period was found to be 2·1 hours, which is due to the known isotope of indium ^{117}In [5]. We thus conclude that the activity of the cadmium fraction is due to ^{117}Cd, the half-life of which turns out according to our measurements to be about 5·5 hours.

Similar procedure was taken with the 2·5-day activity. The cadmium sulphide from an irradiated sample of long exposure was left for about twenty hours before dissolution in hydrochloric acid, until the cadmium isotope ^{117}Cd and its daughter product died away. The indium fraction obtained in the same way as above was examined for activity, and a half-life of 4·5 hours was obtained, which we identify with the known radioactive isomer of the stable indium isotope $^{115}In^*$ [5]. As a consequence, we conclude the 2·5-day activity to be due to a cadmium isotope ^{115}Cd.

It should be mentioned that Be + D neutrons from our cyclotron, and also neutrons slowed down by paraffin, do not appreciably produce silver and cadmium activities as above mentioned. The details of the experiments will shortly be given elsewhere.

The above investigations were carried out as a part of the programme of the Atomic Nucleus Sub-Committee of the Japan Society for the Promotion of Scientific Research. We acknowledge the assistance given by our laboratory colleagues in connexion with the irradiation of samples and by Messrs. N. Saito and N. Matuura regarding the chemical separations.

Y. NISHINA.
T. YASAKI.
H. EZOE.
Nuclear Research Laboratory,
Institute of Physical and
Chemical Research,
Tokyo.

K. KIMURA.
M. IKAWA.
Chemical Institute,
Faculty of Science,
Imperial University of Tokyo.

May 3.

[1] Nishina, Y., Yasaki, T., Ezoe, H., Kimura, K., and Ikawa, M., NATURE, **144**, 547 (1939).

[2] Kraus, J. D., and Cork, J. M., *Phys. Rev.*, **52**, 763 (1937).

[3] Pool, M. L., *Phys. Rev.*, **53**, 116 (1938).

[4] Dodé, M., and Pontecorvo, B., *C.R.*, **207**, 287 (1938).

[5] Goldhaber, M., Hill, R. D., and Szilard, L., *Phys. Rev.*, **55**, 47 (1939); NATURE, **142**, 521 (1938); Cork, J. M., and Lawson, J. L., *Phys. Rev.*, **56**, 291 (1939).

Mass-Radius Relation for a White Dwarf Star

THE peculiar difficulty pointed out by Eddington regarding the ultimate fate of a white dwarf star led Fowler[1] to make the first application of Fermi-Dirac statistics to astrophysics in a fundamental paper which initiated a long series of investigations, particularly by Milne[2], in recent years. The starting point is the expression

$$a(\varepsilon)dt = \frac{gV(2m)^{3/2}}{4\pi^2\,\hbar^2}\ \varepsilon^{1/2}\,dt, \tag{1}$$

which represents (neglecting the effect of relativistic mechanics) the number of wave functions corresponding to eigen-values lying in the energy-range ε to $\varepsilon + dt$ for a *free* electron confined in a field-free region of volume V; this is assumed to hold for the stellar interiors though gravitational and electrical fields are present. For degenerate matter equation (1) leads to the well-known expression for the pressure

$$p = \frac{32\pi^3}{15}\,\frac{\hbar^2}{m}\left(\frac{3\rho}{4\pi g\mu m_H}\right)^{5/3}; \tag{2}$$

which reduces the equation for mechanical equilibrium for a star to Emden's equation of index 3/2 giving the relation ("Emden-solution")

$$R = \frac{\alpha_0 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3} \tag{3}$$

between the radius R and the mass M of a white dwarf. L_0 is a length characteristic of the white dwarf theory

$$L_0 = \frac{\hbar^2}{m\, m_H^{5/3}\, G\, \odot^{1/3}} \doteqdot 6{\cdot}18 \times 10^8 \text{ cm.}, \qquad (4)$$

and

$$\alpha_0 = \left(\frac{9\pi^2\, \omega^\circ_{3/2}}{128}\right)^{1/3} \doteqdot 4{\cdot}51, \qquad (5)$$

where $\odot$ is the solar mass, m the mass of the electron, m_H the mass of the proton, G the gravitational constant, and $\omega^\circ_{3/2} = 132{\cdot}4$ is a number defining the Emden-solution of index 3/2. μ is the mean molecular weight per free electron, $\mu = 1$ for ionized hydrogen and $\mu = A/Z \doteqdot 2$ for any other completely ionized element of atomic weight A and atomic number Z. (The material in the interior of a white dwarf star is completely ionized due to pressure ionization.)

In the case of Sirius B—the most accurately known amongst the white dwarfs—the calculated radius for $\mu = 2$ (hypothesis of hydrogen scarcity) is smaller than the observed value by a factor somewhat larger than 2, but is in accord with observation if the stellar material is assumed to contain about 70 per cent of hydrogen by weight (hypothesis of hydrogen abundance).

However, the hypothesis of hydrogen abundance, as recently emphasized by Eddington[3], Wildhack[4], and Marshak and Bethe[5], is in violent disagreement with the theory of stellar energy generation. It predicts for the white dwarf a luminosity of an order far higher than the observed value, and so it must be discarded. With the elimination of the hypothesis of hydrogen abundance, relation (3) no longer remains in accord with observation.

The present note is concerned, *first* to direct explicit attention to the importance of the electric field in the theory of a white dwarf star, and *secondly* to give a derivation of the mass-radius relation (without recourse to equation (1)) which indicates a possibility of removing the discrepancy noted above between the observed and the calculated radii. We shall for simplicity consider a uniform-density model. As Rosseland[6] showed long ago, an electrical field is set up in a star which prevents any appreciable separation between the free electrons and the atomic nuclei, and for a model of uniform density we must have

$$A m_H u + Z e V = 0, \text{ or } ev = -\mu m_H u, \qquad (6)$$

where u is the gravitational and v the electrostatic potential (both measured from the centre : $u = v = 0$ at $r = 0$). If ξ denotes the Gibbs' free energy per electron, then, from a well-known theorem in thermodynamics, we have

$$\xi_0 - \xi_1 = m u_1 - e v_1 = \mu m_H u_1, \qquad (7)$$

where the suffixes zero and one represent the values at the centre ($r = 0$) and the surface ($r = R$) respectively. ($m u_1 - e v_1$) is the work done in carrying an electron from the centre to the boundary. For degenerate electron gas, if n represents the free electron concentration,

$$\xi = \frac{h^2}{2m}\left(\frac{3n}{4\pi g}\right)^{2/3}, \qquad (8)$$

a result which is ultimately based on (1). Substituting $\xi_1 = 0$ and $u_1 = GM/2R$, we have from (7) and (8)

$$R = \frac{\alpha_1 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}, \qquad (9)$$

$$\alpha_1 = \left(\frac{9\pi}{4}\right)^{2/3} \doteqdot 3{\cdot}68\,; \qquad (10)$$

which is practically identical with (3), and is exactly the expression that is obtained by an application of the *virial* theorem[7]. If the electrostatic field be ignored, we obtain instead of (9) a relation of entirely different order of magnitude, namely,

$$R = \frac{m_H}{m}\,\frac{\alpha_1 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}. \qquad (11)$$

The above discussion brings out explicitly the importance of the electric field in white dwarf theory. We shall now consider the derivation of the mass-radius relation from a different point of view, which appears to be more fundamental.

The Schrödinger equation for an electron inside a white dwarf is

$$\nabla^2\Psi + \frac{2m}{\hbar^2}(E - mu + ev)\,\Psi = 0, \qquad (12)$$

which on using (6), and substituting for a sphere of uniform density

$$u = \frac{GM}{2R^3}\, r^2, \qquad (13)$$

reduces to

$$\nabla^2\Psi + \frac{2m}{\hbar^2}(E - \tfrac{1}{2}\alpha r^2)\,\Psi = 0, \qquad (14)$$

where

$$\alpha = \mu m_H \frac{GM}{R^3}, \qquad (15)$$

This is the wave equation for a harmonic oscillator and gives for E the eigen-values

$$E_l = \hbar\left(\frac{\alpha}{m}\right)^{1/2}(l + \tfrac{1}{2}), \qquad (16)$$

where l is any positive integer. The number of independent wave functions associated with the eigen-value E_l is $gl(l+1)/2$, where g is the weight factor ($g = 2$). In the *degenerate* case the levels from $l = 0$ to $l = l_0$ will be completely filled up, that is, $\sum_0^{l_0} l(l+1)$ would be equal to the total number of electrons ; hence

$$l_0 = \left(\frac{3M}{\mu m_H}\right)^{1/3}. \qquad (17)$$

The amplitude of the oscillator corresponding to the maximum energy E_{l_0} is to be identified with the radius R, and thus we have $E_{l_0} = \frac{1}{2}\alpha R^2$, which gives

$$R' = \frac{\alpha_2 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}, \qquad (18)$$

$$\alpha_2 = (24)^{2/3} \doteqdot 8{\cdot}32. \qquad (19)$$

This is the same relation as (3), but the numerical factor is 1·84 times larger. For Sirius B, (18) gives $R = 1{\cdot}6 \times 10^9$ cm., whereas the observed value is 2×10^9 cm.

The theory here given needs to be refined in many ways ; thus the effect of electron collisions will be to broaden the energy levels, and it might be taken account of in the same way as in the theory of diamagnetism, but nevertheless it is interesting that the mass-radius relation has been obtained in this way.

D. S. KOTHARI.

Physics Department,
University of Delhi.
May 11.

[1] Fowler, *Mon. Not. Roy. Astro. Soc.*, **87**, 114 (1926).

[2] Milne, *Mon. Not. Roy. Astro. Soc.*, **92**, 610 (1932).

[3] Eddington, *Mon. Not. Roy. Astro. Soc.*, **99**, 595 (1939).

[4] Wildhack, *Phys. Rev.*, **57**, 81 (1940).

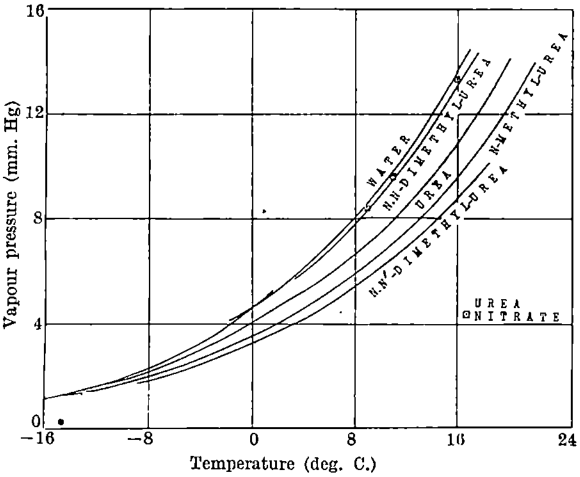
[5] Marshak and Bethe, *Phys. Rev.*, **57**, 69 (1940).

[6] Rosseland, *Mon. Not. Roy. Astro. Soc.*, **84**, 720 (1924).

[7] Kothari, *Mon. Not. Roy. Astro. Soc.*, **96**, 833 (1936).

Deliquescence in Urea and Methyl-ureas

A COMMUNICATION in NATURE from E. A. Werner[1] directed attention to the deliquescence of urea and to the paucity of data concerning the vapour pressures of saturated solutions of urea and its derivatives, apart from the few observations of Adam and Metz[2], and Edgar and Swan[3]. The accompanying figure gives vapour pressure curves for saturated solutions of urea, urea nitrate, N-methyl-urea, N.N- and N.N′-dimethyl-urea determined by the method described by Rowley[4], and records the quaternary point for the system, urea, ice, saturated solution, vapour (−11·3° C.) for the first time.



The vapour pressure curves confirm the observations of Werner upon the absorption of water by urea, etc., the vapour pressure of a saturated solution of urea being at all temperatures below 20° C. less than 14 mm. of mercury; consequently urea will show deliquescence except under conditions of unusually low humidity. The actual humidity required to cause deliquescence in these compounds, expressed as a percentage of the maximum vapour pressure of water at 18° C., is:

Urea nitrate	>95
N.N-Dimethyl-urea	94·3
Urea	80·1
N-Methyl-urea	70·0
N.N′-Dimethyl-urea	63·5

This shows N.N′-dimethyl-urea to be of the order of deliquescence of ammonium nitrate, urea and N-methyl-urea of sodium nitrate, and N.N-dimethyl-urea and urea nitrate of potassium nitrate.

The marked difference in the deliquescence of the methyl ureas is of interest on account of the various structures suggested for these compounds[5].

ARCHIBALD CLOW.

Department of Chemistry,
Marichal College,
Aberdeen.
May 20.

---

[1] Werner, NATURE, 139, 512 (1937).

[2] Adam and Metz, *Ind. and Eng. Chem.*, 21, 305 (1929).

[3] Edgar and Swan, *J. Amer. Chem. Soc.*, 44, 570 (1922).

[4] Rowley, *J. Amer. Chem. Soc.*, 59, 621 (1937).

[5] Clow, *Trans. Faraday Soc.*, 33, 381 (1937).

Examination of ‘Egyptian Blue’ by X-Ray Powder Photography

X-RAY powder photography has been carried out upon various examples of the brilliant azure pigment known as ‘Egyptian Blue’. It has been found as early as the Fourth Dynasty (2900–2250 B.C.) and its use became very widespread throughout the Roman Empire. By this method crude frits from Tel-el-Yehoudi (Egypt), Silchester (Berkshire) and Woodeaton (Oxfordshire) have been shown to be of the same crystal form as a block already prepared for trading from Tel-el-Yehoudi, another in course of preparation from Armant (Egypt), and pale blue finely powdered pigment on pottery from Tel-el-Amarna (Egypt), and on wall plaster frescoes from Woodeaton. A potsherd from Woodeaton contained the same finely powdered pigment and was obviously used as a palette. All these examples were shown to contain essentially copper, calcium, and silica, with varying small amounts of sodium. Laurie and others[1] had previously shown that examples of a similar blue from Egypt, Rome, Knossos (Crete), Syria, and Wroxeter (Shropshire) consisted essentially of a definite compound—$CuO.CaO.4SiO_2$, which assumes this brilliant azure only if formed between 800° C. and 900° C.; outside these limits the frit passes to a green glassy mass.

The crude frits were found in the form of agglomerates of small balls about $\frac{1}{2}$ in. in diameter, and this agrees remarkably well with Vitruvius's description (*c.* 24 B.C.) of the making of the pigment:

“Caeruleum was first made at Alexandria, then by Vestorius at Puteoli. . . . Sand and Natron (native Soda) are powdered together as fine as flour and Copper is grated by coarse files over the mixture. This is made into balls by rolling in the hands. The dried balls are then put into an earthen jar, which is put into a furnace. When the Copper and Sand have coalesced in the intense heat and the separate things have disappeared, the colour Caeruleum is made.” The biconical form of the balls, resulting from rolling in the hands, is especially noticeable in the examples studied.

The application of X-ray powder photography to the study of this pigment provides a simple means of establishing its identity, even in the finely powdered form as it appears in paintings; thus it was possible to identify copper aluminate, $CuAl_2O_4$, as being responsible for the blue colour on one pot from Tel-el-Amarna. It is hoped to extend the use of this method in the technological examination of antiquities.

E. M. JOPE.
G. HUSE.

Oriel College,
Oxford.
May 29.

---

[1] *Proc. Roy. Soc.*, A, 39, 418 ff (1913–14).

Attainment of the Upright Posture of Man

IN his recent paper entitled “Fifty Years Ago”[1], Sir Arthur Keith tells how, when in Siam in 1890, he became impressed by the similarity in muscular and visceral adaptations shown by the hand-swinging gibbon and bipedal orthograde man. The gibbon suspends its body in an upright posture by hanging from its hands; man maintains his upright posture by standing on his feet. It was, therefore, an easy step to assume that the brachiating gibbon had paved the way to human uprightness. The story of this assumed transition is most graphically told in Sir Arthur Keith's little book "The Human Body", and it has become the creed of what W. K. Gregory of New York terms "the orthodox school". This brachiating hypothesis of the origin of man's upright attitude has been accepted by practically all English-speaking anthropologists and palæontologists. We may cite the Romanes Lecture of 1928 by Prof. D. M. S. Watson, the works of the late Sir Grafton Elliot Smith and many others in its support. This orthodox school, as represented by Gregory, claims that the brachiating habit is "a necessary introduction to the upright posture of Man", and man is defined by the same authority as "a made-over brachiator adapted to life on the ground" ("Man's Place among the Anthropoids", 1934).

This brachiating hypothesis of the origin of human uprightness I have had the temerity to contest for many years. In "Man's Place among the Mammals" (1929) I have set forth more fully the reasons that had made me reject the thesis in my first publication on the subject in 1916. In brief, I have always maintained: (1) that bodily uprightness was attained in the most primitive haplorrhine Primates long before the brachiating specialization of the anthropoid apes had been acquired; and (2) that as these primitive Primates showed the primitive condition of having the hind limb longer than the fore limb, it was, at least, unlikely that the human stock had ever become specialized as a brachiating form, with the fore limb longer than the hind limb (as is the case in all anthropoid apes) and afterwards reverted to the primitive condition of having the hind limb longer than the fore limb, as is the case in all known stages of the human phylum.

Perhaps I may be permitted to quote from Gregory, who has stated my views in his own language: "Professor Wood Jones has sought to depreciate the resemblances of the brachiating skeleton of the Gibbon to the upright bipedal skeleton of Man by claiming that the habit of brachiation has led to over-specialisation for arboreal life and has for ever prevented the anthropoids from entering upon the human path of evolution" (*op. cit.*, p. 17). This very fair statement of my views was made by Gregory in order to show how thoroughly biased and how completely erroneous they were. It is, therefore, of some interest to find that, towards the end of his latest paper, Sir Arthur Keith says: "I will add here two brief notes. (1) At that time I regarded the Gibbon as a representative of the pioneers of the orthograde stock and that Man and the great anthropoids had passed through a hylobation phase of evolution. It would take me too far afield to give the evidence which led me to abandon this opinion. Suffice it to say I now think that when the Gibbons were in their early stages of evolution (*probably in late oligocene times*) and developing along brachiating lines, two other modes of orthograde posture were also being evolved in the same stock. In one, both arms and legs were being used almost equally—the ancestral form of Gorilla and Chimpanzee; in a third—the ancestral human orthograde stock—the lower limbs were being developed as the chief organs of support and locomotion. All were arboreal in habitat". In this passage I have italicized one paragraph and will refrain from employing it as a direct negation of the views of the "orthodox school" and to Sir Arthur Keith's own published statements as to the period of divergence of the human stock from the phylum of the Catarrhini. Were I to be writing in the reminiscent strain of "Fifty Years Ago" I would record my satisfaction that Sir Arthur Keith and I (who was his student in 1897) are now in accord on this matter. If, as Sir Arthur postulates, the lower limbs of the human stock were becoming developed as organs of support and locomotion in "late oligocene times", it seems obvious that those adjustments regarding the position of the human stock in the phylum of the Primates, which I have long advocated, are no longer to be stigmatized as being unorthodox. One may indeed be permitted to wonder if those of the "orthodox school", deserted by the originator of the "brachiating hypothesis", will remain suspended by their hands or will descend to earth. In any event, their descent to earth will, like that of the existing anthropoid apes, indelibly bear witness to their apprenticeship of brachiating.

F. WOOD JONES.

Department of Anatomy,
University of Manchester.
March 27.

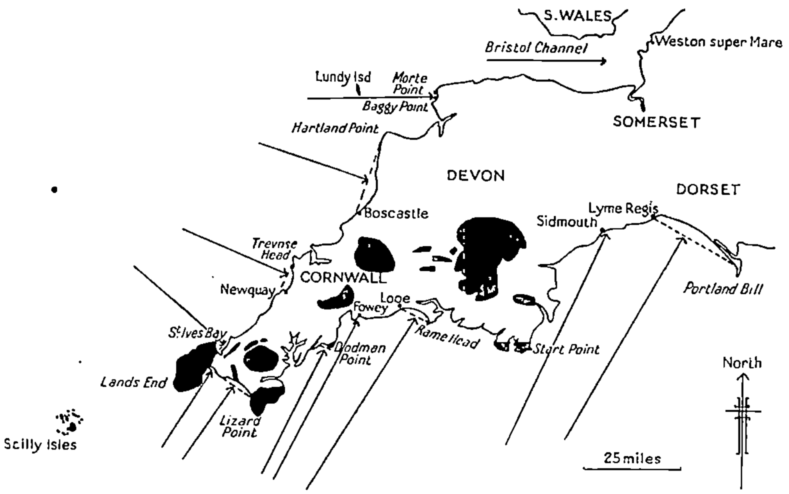
Amer. J. Phys. Anthrop., 5, 26 (March 30, 1940).

Outline of South-West England in Relation to Wave-Attack

A THEORY has recently been put forward by Mr. W. V. Lewis[1] that the general line of a shore tends to be at right angles to the direction of dominant wave-attack, and he points out that while a stretch of coast is in the process of adjustment to this attack, bays tend to become asymmetrical with the longer, smoother side facing the quarter from which the dominant waves approach. Among other examples, he cites the Chesil Beach from Chesilton to West Bay, and the coast of the Bristol Channel near Weston-super-Mare, where smooth stretches of shore face towards the open sea at right angles to the direction of dominant wave-approach.

It seems possible that this theory may be applicable to phenomena on an even larger scale, and that the major features of the coastal outline of Cornwall, Devon, west Dorset and west Somerset may be broadly interpreted on the same hypothesis. The south coast of the peninsula is divided into large bays by the headlands of the Land's End, Lizard Point, Dodman Point, Start Point and Portland Bill. In each of these bays, the western side (facing in a more or less easterly direction) is much indented into minor bays, divided by angular promontories, while the eastern side (facing south-west) is comparatively smooth, with blunted headlands. If, in each bay, a line (indicated by an arrow on the accompanying sketch-map) be drawn at right angles to the chord of the smoother eastern arc (shown by dots), it is found that its direction of approach to the coast is approximately from the south-west, and hence from the nearest part of the open Atlantic, clear of Cornwall and Brittany. The smoother eastern side of the bays therefore faces the dominant waves which approach from the nearest part of the open ocean.

In each bay, that deduced line of wave-approach from the south-west which passes the boundary-headland at a tangent is found to reach the coast at, or somewhat to the west of, the apex of the bay, where the indented western stretch turns to the smoother eastern arc. This shows how the form of the bay is directly controlled by the superior resistance to erosion of the rocks of the major headlands (marked on the map in solid black). The Land's End is a granite mass, and the Lizard, Dodman and Start Points consist of Pre-Cambrian igneous or metamorphic rocks. The irregular western stretch is that which is protected by the major headland to the west of it, while the smoother eastern arc is that on which the waves can act directly. The stretches from Lyme Regis to Sidmouth, and from Looe to Fowey, between the apex of the bay to the east and the point to the west where the headland-tangent strikes the coast, may be regarded as not yet fully aligned by the wave-attack, and these stretches are likely, even when ultimately adjusted, to remain always more curved than the coast farther to the east, on account of the waves being deflected by the proximity of the boundary-headland. The coast between Start Point and Rame Head also remains at present irregular, since the drowning of the estuaries appears to be the primary factor controlling its outline.



SKETCH-MAP OF SOUTH-WEST ENGLAND; OUTCROPS OF IGNEOUS AND METAMORPHIC ROCKS IN SOLID BLACK. ARROWS INDICATE ASSUMED DIRECTIONS OF CONTROLLING WAVE-ATTACK.

A corresponding form of bay, with a smoother eastern arc and indented western stretch, is found also on the north coast of Cornwall and Devon. Here, as on the south coast, the dominant waves offshore presumably approach from the open Atlantic to the south-west, but their impact on the north coast is therefore oblique, so that it is not these waves which produce the maximum effect on the shoreline. The smoother eastern arc of St. Ives Bay, and the chords running from Trevose Head to Newquay, from Hartland Point to Boscastle, and from Morte Point to Baggy Point, face north of west or west, and probably it is from the open Atlantic in this direction, clear of Ireland, that the largest waves can approach approximately at right angles to the coast, and thereby model the shoreline. Between Morte Point and the area already described by Mr. Lewis near Weston-super-Mare, the general lie of the coast of the Bristol Channel is east and west, parallel to the direction of wave-attack and therefore relatively little affected by it.

I wish to thank Mr. W. V. Lewis for his helpful criticism of these suggestions, which are put forward tentatively as being at present only of rough application. I am hoping later to be able to make a more detailed study of the factors controlling the outline of south-west England.

MURIEL A. ARBER.

Sedgwick Museum,
Cambridge.
May 17.

---

[1] Summarized in Lewis, W. V., "The Evolution of Shoreline Curves", *Proc. Geol. Assoc.*, 49, 107–127 (1938).

Vitamin-Free Diets for Animal Experiments

IN GREAT BRITAIN many workers on vitamins have used basal diets containing rice starch as the sole or predominant source of carbohydrate. In our laboratory that practice has been followed over many years for diets used in work on vitamin A, vitamin B_1, the rat 'filtrate factor', the 'eluate factor' (vitamin B_6) or vitamin E.

The difficulty of obtaining from our usual sources further supplies of rice starch after the outbreak of war led us to investigate the possibility of replacing it by wheat starch. We have found that this has in no way impaired the suitability of our diets used for work on vitamin A, vitamin B_1 or vitamin E.

Thus, 22 male and 10 female newly weaned Wistar albino rats, of the London strain, were fed upon our standard vitamin A-free diet, in which the change of starch had been made; all the animals reached a growth plateau in the usual time—25–31 days—and all animals receiving no supplementary vitamin A died within 40 days. Those animals that received, from the time of reaching a growth plateau, a twice-weekly dose of the International Standard Preparation of vitamin A, corresponding with daily intakes of 2 or 4 international units, responded normally. Of the 20 animals receiving no supplement, 14 developed xerophthalmia; of the 12 afterwards given vitamin A, 4 at some time showed signs of xerophthalmia, which disappeared before the experiment ended. These and other similar results are indistinguishable from those obtained with the diet containing rice starch.

Again, 65 animals receiving our vitamin E-free basal diet, in which the change of starch had been made, were positively mated to normal bucks: all underwent typical gestation-resorptions.

On the modified vitamin B_1-free basal diet, 32 males and 6 females ceased to show any increase in weight after 14–20 days. After 21 days administration of vitamin B_1 (crystalline aneurine chloride hydrochloride, 2·25 and 4·5 μgm. per day) 13 males and 1 female showed normal increases in weight. Of 6 males and 4 females receiving no supplement of vitamin B_1, 9 died between the thirty-eighth and the forty-seventh day of the experiment, most of them after a marked rapid decline in weight and with external symptoms (vertigo) of avitaminosis-B_1. (One male survived a test period of 56 days without supplementary vitamins, showing no loss or gain on his starting weight.) Here again, replacement of rice starch by wheat starch produced no demonstrable effect.

We have, however, found wheat starch unsuitable for diets used in work on the rat 'filtrate factor'. Our animals never reach a true growth plateau on a filtrate-factor-free diet, but their weight-increase slows down to such an extent that statistically significant differences in weight-increases can be produced by supplements of filtrate factor in the ratio of 2 : 1, provided suitable response levels are chosen. This is an adequate basis for reasonably accurate vitamin assay. When, however, wheat starch replaces rice starch in our routine diet used for these tests, many of the animals show no slackening of growth after 4 weeks : discrimination between negative controls and animals receiving filtrate factor concentrate made from 32 gm. of fresh liver is seldom possible. With the rice starch-containing diet, groups of 3 animals are sufficient to detect the presence of such a concentrate in amounts made from only 8 gm. of liver. It would appear that the wheat starch we used had adsorbed or otherwise retained appreciable quantities of filtrate factor from the wheat berry.

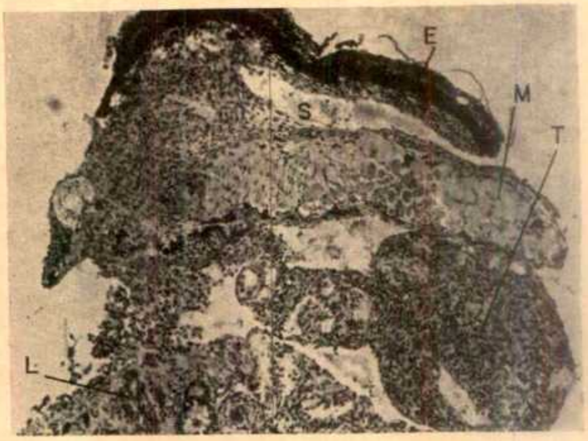
We have no information about the effect of wheat starch on diets used for work on vitamin B_6 (adermin, 'eluate factor').

Glaxo Laboratories, Ltd., A. L. BACHARACH.
Greenford,
Middlesex. June 4.

Tumour Induction in *Rana pipiens* Tadpoles

DURING the normal development of Amphibians the well-known 'fields' of organization operate to induce morphological differentiation[1]. Furthermore, adult Urodeles and larval Anurans are known to retain local fields which are active in the regeneration of parts[2]. Therefore, problems in abnormal growth may well be studied in those Amphibians which retain power of regeneration. One of the commonest present-day methods of experimentally producing abnormal growth is by means of carcinogenic substances, but apparently these substances have been little used for such studies in Amphibia. Recently, however, Koch, Schreiber and Schreiber[3] have induced tumours in adults of *Triton cristatis* and *Triton taeniatus* with 1 : 2 benzpyrene and with carcinogenic tar. The present report deals with induction experiments with *Rana pipiens* tadpoles using methylcholanthrene-choleic acid as the carcinogenic agent.

During February and March of 1939, 154 young tadpoles (20–30 mm. total length) were each injected subcutaneously near the base of the tail or behind the ear with about 0·2 mgm. of methylcholanthrene-choleic acid in crystalline form or in solution in lard. Healing occurred satisfactorily immediately after the operation, but during the subsequent three or four weeks, the skin above the injected mass perforated and the carcinogen was lost in most cases. 94 control tadpoles were injected with lard alone or with paraffin. All animals were reared at room temperature (c. 22°). Eleven experimental and four control tadpoles died and were autopsied before metamorphosis ; they had developed no growths. All of the surviving animals were autopsied during June, July and August of 1939 at about the time of metamorphosis. Thirty-nine of the ninety-four control tadpoles had retained the lard or paraffin ; no growths were found. Of the original 154 experimental tadpoles only 12 retained the injected mass and in 3 of these subcutaneous tumours had developed in tissue surrounding the carcinogen. In two cases (*MC* 512 and *MC* 711) observed 95 and 158 days after injection respectively the tumour remained localized, forming a firm, non-pigmented mass of tissue about 2 mm. × 1 mm. × 0·5 mm. in size in hosts of about 22 mm. body length. In the third case (*MC* 62–119 days) the induced tumour showed signs of malignancy. From the injection site it had spread subcutaneously, penetrating the body wall musculature and invading the posterior part of the left lung. At the time of autopsy it covered an area of 5 mm. × 1·8 mm. and was 1 mm. to 1·5 mm. thick. This is a large tumour in proportion to the size of the host—a metamorphosing tadpole of 18 mm. body length.



TUMOUR INDUCTION IN *Rana pipiens* TADPOLES (× 61).

The accompanying photograph illustrates some of the structural features of this growth. From the original site of injection in the loose subcutaneous tissue (*S*), the tumour has grown outward, spreading along the base of the dermis (*E*). Growing in the opposite direction, it has penetrated the body wall musculature (*M*), expanded as a sizable mass in the coelom (*T*) and invaded the lung wall (*L*). Histologically it appears to be a connective tissue tumour of mixed cell type. Cells are spindle-shaped, round, or intermediate ; also they are quite variable in size. Generally the cells are closely packed and give no evidence of differentiation.

One of the two localized tumours (*MC* 711) presents the same histological picture as that described above for *MC* 62. The second localized tumour (*MC* 512) was transplanted subcutaneously [illegible]to five tadpole hosts. Apparently the tumour tissue did not take in this small number of cases, for no abnormal growths have appeared in six months.

This work was supported by the International Cancer Research Foundation.

Department of Zoology, R. W. BRIGGS.
McGill University,
Montreal.
April 29.

---

[1] Spemann, H., "Embryonic Development and Induction" (New Haven, Conn. : Yale University Press, 1938).

[2] Weiss, P., "Principles of Development" (New York : Henry Holt and Co., 1939).

[3] Koch, C., Schreiber, B., and Schreiber, G., *Bull. de l'Association française pour l'Étude du Cancer*, **28**, 852 (1939).

'Congenital' Copper Deposit in the Rat

THE striking increase in the copper concentration of the human liver, which begins during fœtal life and reaches its maximum at birth, has not yet been satisfactorily explained. Since the importance of copper as a catalyst for hæmoglobin formation is now conclusively proved for many higher animals, most authors consider the 'congenital copper deposit', too, to be connected with this function. Two hypotheses have been suggested in this respect: (*a*) copper is accumulated in the fœtal liver, because this is the chief site of blood formation during embryonic life; (*b*) copper is stored in the fœtal liver to compensate for the low copper content of milk during lactation, just as in the case of iron.

We have recently[1] raised some criticism against both views, which we see now supported by our new findings in the rat species.

Figures for liver copper in young animals are somewhat meagre. Cunningham[2] finds in seven species (bovine, sheep, pig, dog, guinea pig, rabbit and rat) similar conditions as in man, that is, highest values at birth and a rapid drop during the lactation period towards the low final level. Ramage[3], Wilkerson[4] and McFarlane and Milne[5], on the other hand, working with goat, pig and chick embryos respectively, observe the peak already during fœtal life and more or less low figures at birth.

During a study of iron, copper and hæmoglobin in white rats of various ages we were much surprised to find a marked increase of liver copper still after birth, the maximum not being reached before the 10–15th day of life (see accompanying table). Copper was determined by the dithiocarbamate method, non-hæmin iron by our hot pyrophosphate method[6], hæmoglobin spectro-colorimetrically.

The phenomenon occurred with great regularity in each of seven litters which had been followed from birth on during the first weeks of life; it contradicts the findings of Cunningham[2] who, however, has only examined one litter. The peak was always reached between the 10th and 15th day, nearly coinciding with the opening of the rat's eyes. It may be recalled here that the rat is born in a rather embryonic state of development, a fact which is also reflected in its red blood picture[7].

In contrast to the liver, the percentage of copper in the whole body was found to drop gradually from birth on, as already shown by Lindow *et al.*[8]

Histological examination, kindly carried out by Dr. H. Karplus, of some of the livers revealed no correlation between copper content and hæmopoietic activity of the liver; that was to be expected since this activity is highest during the early fœtal life—in birds and mammals—and has nearly disappeared at birth.

Our findings make hypothesis (*a*) untenable, and the same is true for the 'deposit' hypothesis (*b*), since the increase occurs just during lactation, and in spite of a general decrease in the body copper concentration.

Age (days)	Liver-Copper		Liver-Iron		Hæmoglobin	
	Average	Range	Average	Range	Average	Range
0–1	97 (13)	62–133	1790 (16)	1180–2650	12·1 (60)	7·3–15·3
5–7	134 (6)	82–174	1245 (5)	650–2000	8·8 (6)	7·8–9·4
10–14	206 (7)	133–270	670 (6)	330–1130	10·9 (7)	9·5–11·8
15–17	124 (10)	54–204	340 (4)	137–500	—	
20–22			315 (9)	82–1240	10·4 (9)	8·0–13·4
32–44	33 (8)	21–50	620 (8)	450–895	*12·3 (5)	11·6–13·5

* 30–34 days.

Copper, non-hæmin iron (mgm. per kgm. dry weight) and hæmoglobin (gm. %) in young rats. (Figures in brackets indicate number of animals.)

It appears to us that the rather dramatic accumulation of copper, occurring in different species at different times and paralleled by a similar increase in the copper content of young rapid-growing plant tissues, is not associated with the process of hæmoglobin formation but with growth and development, a view already suggested previously[9,10,11]. We are not yet prepared to say what particular process may be connected with the increase of liver copper; but the recent identification of several oxidases as copper proteins and the isolation of similar compounds from blood and liver[12] open many possibilities in this respect.

A detailed report of our experiments will be published elsewhere.

G. BRÜCKMANN.
S. G. ZONDEK.

Chemical Laboratory,
Department of Internal Medicine,
Hadassah Municipal Hospital,
Tel-Aviv.
May 7.

---

[1] Brückmann, G., and Zondek, S. G., *Biochem. J.*, **33**, 1845 (1939).
[2] Cunningham, J. J., *Biochem J.*, **25**, 1267 (1931).
[3] Ramage, H., *Biochem. J.*, **28**, 1500 (1934).
[4] Wilkerson, V. A., *J. Biol. Chem.*, **104**, 541 (1934).
[5] McFarlane, W. D., and Milne, H. I., *J. Biol. Chem.*, **107**, 309 (1934).
[6] Brückmann, G., and Zondek, S. G., *J. Biol. Chem.* (in the press).
[7] Wintrobe, M. M., and Shumacker, H., *Amer. J. Anat.*, **58**, 313 (1936).
[8] Lindow, C. W., Peterson, W. H., and Steenbock, H., *J. Biol. Chem.*, **84**, 419 (1929).
[9] Herkel, W., *Ziegler's Beitr. path. Anat.*, **85**, 513 (1930).
[10] Sheldon, J. H., and Ramage, H., *Biochem. J.*, **25**, 1608 (1931).
[11] Zondek, S. G., and Bandmann, M., *Dt. Med. Wochenschr.*, **91** (1933).
[12] Mann, T., and Keilin, D., *Proc. Roy. Soc.*, B, **126**, 303 (1938).

Use of Desiccated Chick Embryo in Tissue Culture Technique

ONE of the difficulties inherent in tissue culture technique is the necessity for a regular supply of chick embryo extract, without which serial subcultures cannot be maintained. When fresh 9–11 day embryos are used, it is almost impossible to avoid a waste of material as it is necessary to incubate more eggs than will probably be required in order to ensure a sufficient supply of embryos.

At the commencement of the War, we decided to try desiccated 9–11 day chick embryos as a source of active principle, and, since November 1939, have successfully maintained a variety of cultures of normal and malignant tissues on fowl plasma clot, to which this extract was added. By parallel experiments, in which fresh embryo was compared with desiccated embryo, it was found that extracts of the two were equally effective. The desiccate was recon[illegible]tuted by adding sterile distilled water up to the original volume. Aqueous extract prepared from such reconstituted material has better keeping qualities than fresh extract and can be used for ten days without apparent loss of efficacy.

In the dry state, the desiccate keeps without apparent loss of active principle for at least seven months; our desiccate has been kept in a refrigerator at 4° C., but this precaution may not be necessary. The desiccate can be prepared at short notice, and may be regarded as a standard reagent.

The following tissues have been grown progressively by this technique: (1) normal 17-day chick embryo heart muscle, for four weeks; (2) normal 18-day chick embryo fibroblasts, for four weeks; (3) Jensen rat sarcoma, for five weeks; after which, re-inoculated cultures grew in rats; (4) fowl-grown Fujinami filterable sarcoma, for 4–6 weeks, after which re-inoculated cultures grew in fowls; (5) *GRCH*/15 non-filterable sarcoma, for 4–6 weeks, after which re-inoculated cultures grew in some fowls.

The economy in time and material that is rendered possible by this technique recommends it, particularly under war conditions, as it is possible to incubate sufficient eggs when they are plentiful and when fertility is high to maintain cultures throughout the rest of the year. Thus, it is unnecessary to maintain an egg incubator in constant service. By using the infertile eggs (removed after twenty-four hours incubation) for cooking purposes, waste of material can be completely eliminated.

P. R. Peacock.
R. I. Shukoff.

Research Department,
Glasgow Royal Cancer Hospital.
May 28.

Vision and the Photochemistry of Visual Purple

Visual purple extracted from frog retinæ which is embedded in solid gelatine films ('artificial retina') reproduces on exposure to coloured light various phenomena of scotopic and photopic vision[1,2,3]. It is liable to 'general bleaching' or to 'colour selectivity' by photochemical processes. Both can be recorded by plotting the decrease of extinction against wave-length. If general bleaching occurs, the maximum of the graph (namely, at 530 mμ in the artificial retina) is independent of the spectral composition of the exposing light. In colour selectivity the maximum of the 'colour graph' coincides with the dominant wave-length of the coloured light for a normal trichromat. This forms the basis of an objective colorimetry[3].

The following conception accounts for the results obtained with the artificial retina[3]. Visual purple is a protein which is conjugated with a great number of caroteneic groups[4]. Its smooth absorption curve with a single maximum in the green is due to a mutual interaction of all the chromogenic groups. Monochromatic light of wave-length λ is supposed to produce an isomeric visual-purple-λ by a *cis-trans* transformation of a few double bonds[5]. After this change, the absorption curve of visual-purple-λ is still smooth with a slight decrease of extinction at λ, which accounts for the maximum of the colour graph at λ. Visual-purple-λ may be produced either by monochromatic light or by light of an appropriate spectral mixture. For example, visual-purple-589 may be formed by the *D*-lines, or by a mixture of monochromatic green and red, or by white light which has passed through a yellow filter, or a blue absorbing filter. By white light or by an appropriate mixture of various coloured lights (for example, complementary couples), visual purple is supposed to be decomposed into fragments, and general bleaching with its constant maximum at 530 mμ occurs. This also happens during a purely chemical after-effect in the dark. The two maxima of the colour graphs which are recorded in whitish coloured lights are therefore due to two different photochemical processes. Red light ($\lambda > 650$ mμ) decomposes visual purple on extended exposure and thus produces a secondary maximum of the colour graph at 530 mμ. Since the fragments are still colour selective from yellow to blue, it is probable that the original molecule is merely split into two parts. Extended exposure to blue light, on the other hand, is supposed to peel off photochemically the outer chromogenic groups of the molecule, leaving a residue which is found to be colour selective from red to green. The interpretation of the details of the experiments meets with no difficulties.

If the same processes occur in the living retina, it is obvious that vision is a chemical sense, with the sense of smell as its counterpart. The products of decomposition of the original visual purple stimulate the terminals of the optic nerve to produce a colourless sensation in scotopic vision, and a white sensation in photopic vision. The various isomeric visual-purple-λ stimulate coloured sensations with the dominant wave-length λ. Together with the products of decomposition they stimulate the mixed sensation of whitish hues. It is likely that colour blindness is due to a defect of the retinal tissues to build up the complete molecule of visual purple and that the synthesis does not proceed beyond the yellow-to-blue and red-to-green colour selective fragments.

From Hecht's experiments[6] it follows that the molecule of visual purple has the shape of a slightly oval particle. By assuming that the molecule is an ellipsoid with three unequal axes, the shortest axis would correspond to the strongest optical interaction of the chromogenic groups which makes them absorb red light. The longest axis would determine the absorption of blue, and the intermediate that of green light. The change of the molecule along these axes would stimulate the sensation of the three fundamental hues, and this conception would link the 'three-component' theory of colour vision with our photochemical hypothesis, which postulates an equivalence of all distinguishable hues.

F. Weigert.

Northwood, Middlesex.
May 28.

---

[1] Weigert, F., and Nakashima, M., *Z. phys. Chem.*, B, **7**, 25 (1930).

[2] Weigert, F., and Morton, J. W., Nature, **143**, 989 (1939).

[3] Weigert, F., and Morton, J. W., *Ophthalmologica*, **99**, 145 (1940).

[4] Wald, G., *J. Gen. Physiol.*, **19**, 351 (1935–36); **22**, 775 (1939).

[5] Kuhn, R., lecture delivered to the Royal Society (see Nature, **143**, 1036; 1939).

[6] Hecht, S., and Pickels, E. G., *Proc. Nat. Acad. Sci.*, **24**, 172 (1938).

Species Variation in the Insulin Content of Pancreas

Although the administration of a diabetogenic anterior pituitary extract diminishes the insulin content of the pancreas of the dog[1], treatment with similar extract increases the amount of insulin to be found in the pancreas of the rat[2]. In the course of an investigation into the influence of pituitary extract on the pancreatic insulin content of different species, we have observed substantial differences in the amount of insulin found in the pancreas of normal members of a number of species (see accompanying table). In particular, as the data in the table show, the insulin content of the normal guinea pig pancreas is very much lower than that of any of the other species we have examined, a result which was somewhat unexpected in view of the well-defined β cells to be found in the pancreatic islets of this species. These β cells contain chromaphil cytoplasmic granules which

INSULIN CONTENT OF PANCREAS OF DIFFERENT SPECIES.

Species	Weight of pancreas (gm./100 gm. body weight)	Insulin content of pancreas	
		Units/gm. pancreas	Units/100 gm. body weight
Chimpanzee	0·09	11·2	1·01
Dog	0·23	3·3	0·76
Cat	0·21	2·2[4]	0·47[4]
Rabbit	0·15 0·13	9·5 7·8[5]	1·42 1·17[5]
Guinea pig	0·37 0·31	0·08 0·23[5]	0·028 0·070[5]
Rat	0·48	1·3	0·62
Mouse	1·10	1·7	1·87

(Methods are those of Marks and Young (1939) unless otherwise indicated.)

are influenced by the blood sugar-level[3] and appear to be associated with the insulin-secreting mechanism.

When insulin was dissolved in an extract of guinea pig pancreas, only about 50 per cent of the expected activity could be found in the biological assay (mouse test), although the apparent activity of the insulin was not reduced if an acid aqueous solution of insulin was injected into one side of the mouse while the extract of guinea pig pancreas was simultaneously injected into the other. Substances in the extract therefore appear to interfere with the absorption of insulin from the subcutaneous tissues; but it is improbable that such an effect could entirely account for the fact that guinea pig pancreas appears to contain only about 1/15 the amount of insulin found in the pancreas of the rat.

Preliminary experiments have shown that the mouse resembles the rat in exhibiting a rise of pancreatic insulin content as the result of treatment with crude ox anterior pituitary extract, whereas the rabbit pancreas, like that of the dog, exhibits a fall in insulin content under similar conditions. With the rabbit, however, the fall was not so great as with the dog, a fact in keeping with the less consistent response of the rabbit to the diabetogenic action of a crude anterior lobe extract[6].

H. P. MARKS.
F. G. YOUNG.

National Institute for Medical Research,
London, N.W.3.

---

[1] Best, C. H., Campbell, J., and Haist, R. E., *J. Physiol.*, **97**, 200 (1939).

[2] Marks, H. P., and Young, F. G., *Chem. and Ind.*, **58**, 652 (1939); *Lancet*, i, 493 (1940).

[3] Woerner, C. A., *Anat. Rec.*, **71**, 33 (1938); **75**, 91 (1939).

[4] *cf.* Scott, D. A., and Fisher, A. M., *Amer. J. Physiol.*, **121**, 253 (1938

[5] Picrate insulin extraction method of Dodds, E. C., and Dickens, F., *Brit. J. Exp. Path.*, **5**, 115 (1924).

[6] Young, F. G., *Biochem. J.*, **32**, 513 (1938).

Concentrated Plasma in Histamine Shock

Best and Solandt[1] recently reported that the intravenous injection of pituitrin and concentrated serum produces beneficial effects on blood-pressure in dogs suffering from traumatic shock or histamine poisoning. We have studied the effects of various fluids in thirty cats injected with 5 mgm. of histamine per kgm., which in control experiments produces death within two hours. Animals receiving intravenously 10–25 c.c. per kgm. of concentrated plasma (concentrated to one half or one third its original volume) within ten minutes of the histamine injection survived for more than four hours and the blood pressure usually recovered to about normal level. Intravenous saline was ineffective. Normal plasma or gum-saline were also less satisfactory, generally producing only a short-lived rise of blood pressure. The administration of concentrated plasma may thus be of value in patients suffering from severe traumatic shock or other conditions associated with markedly increased capillary permeability.

C. A. KEELE.
H. H. KWIATKOWSKI.

Department of Physiology,
Middlesex Hospital Medical School,
London, W.1.
May 24.

---

[1] Best, C. H., and Solandt, D. Y., *Brit. Med. J.*, i, 790 (1940).

Prevention of Seedling Blight in the Flax Crop

SEEDLING blight, caused by *Colletotrichum Lini* (Westerd.) Toch., is a disease of flax which is likely to assume greater importance should the cultivation of flax and the home-saving of seed become more widely and intensively practised. The parasite is seed-borne and damage caused by it to the crop would be largely prevented if a satisfactory method of seed disinfection, whereby the parasite is killed and the germination of the seed unimpaired, could be found.

In view of the possibility of seed-borne diseases of flax becoming of greater import, the problem of their prevention has occupied the attention of the Plant Disease Division of the Northern Ireland Ministry of Agriculture for the past two years. During this time rapid and accurate technique has been evolved for the examination of flax seed samples for seed-borne parasites, and a sorting test has been devised for the rapid discrimination between likely and unlikely seed dressings applied for the purpose of parasite extermination.

During the summer of 1939 a large number of chemical dressings were examined by the sorting test for the purpose of determining their efficiency, and among a range of materials submitted by the Imperial Chemical Industries, Ltd., an experimental product styled *R.D.* 7846 and containing tetramethylthiuram disulphide as its active constituent gave very promising results. One very pleasing feature of this product is that it is apparently non-poisonous. It is in the form of a finely divided powder and gave satisfactory results when applied to the seed at the rate of 3 gm. per 500 gm. (approximately 5 oz. per bushel of 54–56 lb.).

More extensive trials with the use of this material have been planned for 1940, and from preliminary results in the field which have already been obtained, the promise shown by the laboratory tests has been upheld. So far no phytocidal effects have been observed in the crops and the attack of seedling blight has been reduced to negligible proportions.

This statement should be regarded as of a preliminary nature and it merely records the possibility of *R.D.* 7846 being a suitable flax seed dressing for the prevention of seedling blight. It is not suggested that this fungicide is the most suitable for the prevention of other or all seed-borne diseases of flax, but owing to the possibility of the growing importance of seedling blight it is felt that this observation merits serious attention, especially at the present time.

A. E. MUSKETT.
J. COLHOUN.

Ministry of Agriculture,
Plant Disease Division,
Queen's University,
Belfast. May 23.

RESEARCH ITEMS

Abnormalities of Speech and the Development of Language

A TENTATIVE classification of abnormalities of speech observed in children and defectives has been put forward by Leopold Stein, speech therapist of the Tavistock Clinic, London (*Brit. Med. J.*, June 1, 1940). In a baby of any race the first sounds observed are cries which correspond solely to emotional states of mind (fear, cold, hunger, etc.). These are at first mere reflex activities, and it is difficult to decide if they are articulate or not. As reflex activities, however, they represent a step in the recapitulation of phylogenetic development (animals' cries). Between the second and fifth week the primitive squall begins to be differentiated, among its special forms being the glottal stop, a primitive and very ancient symbolization related to all negative emotions such as fear, evinced, for example, in an advanced stage of stammering. Further, all children show a certain preference for nasal resonance in song and speech, like primitive peoples. In the babbling period there appears from about six months the so-called primitive sounds, the "Urlaute" (Russmaul, 1877), which it is assumed first appeared among mankind and from which developed the languages of to-day. It is richer in sounds than is required in after-life, while another characteristic is lallation, that is, the reiteration of syllables. They are not at first purposive, but become so. By comparison with a primitive language such as Hottentot, especially as regards primitive sounds such as 'clicks', and repetitions, this period appears also to be a recapitulation of one of the earliest phylogenetic periods of linguistic evolution. Next follows the period of linguistic babbling, when the child attempts to express wishes and ideas by imitation of the sound symbols of his surroundings, and when it has to adopt group modes of behaviour in this respect. The articulatory movements of the growing individual become canalized and conventionalized in the standard speech. In the study of abnormalities a child may develop idioglossia, that is, a language of its own; this is not a gibberish, but is found on study to be subject to certain laws of sound-changes, which may easily be compared with the phonetic changes in the historical development of languages.

Body Build

PROF. RAYMOND PEARL in seeking a formula for an index of body build (*Amer. J. Phys. Anthrop.*, 26, March 1940) points out that the importance of body build or bodily habitus in appraising the general biological constitution of the individual has long been recognized, more especially ever since Kretschmer (1925) emphatically and persistently directed attention to the correlations between habit of body and psychological and temperamental characteristics. A variety of proposals for a measure of bodily habitus has been made but none is completely ideal, since the human body is from a geometrical point of view a solid of an extremely complex shape, which it is difficult to express adequately by any simple numerical statement or formula. The biological root of the difficulty lies in the fact that changes in the size of the body from the pre-natal period to advancing age occur in all three of the fundamental reference planes of the body, length, breadth and thickness. Further correlation is low in degree and irregular. After surveying the various proposals and reviewing the desiderata, it is suggested that a bodily habitus index in use in the author's laboratory would seem to meet fairly most of the requirements. The formula in its most general form is: Habitus Index $= \frac{100\ (\text{chest girth} + \text{abdominal girth})}{\text{stature}}$. It is evident that the values of the index increase as we pass from extreme asthenic individuals, tall and 'skinny', who will have the lowest indexes, to the extreme pyknic individuals, short and stout, who will have the highest indexes. Secondly, the index is dimensionally homogeneous, involving only linear measurements. Further, all three of the dimensions are definitely located and are biologically significant. By actual trial on observed material this index proves to reflect in a sensitive manner differences between individuals in body build, and in the same individual differences consequent upon changes in body build with advancing age.

Insect Fauna of a Hornbill's Nest

IN the *Entomologists' Monthly Magazine* of May 1940, E. B. Britton, of the Department of Entomology, British Museum (Natural History), discusses the insects sent to him by R. E. Morgan from a nest of the silvery cheeked hornbill (*Bycanistes cristatus* Rüpp) at Amani, Tanganyika. Altogether some 438 individual insects were sent from the rotten wood forming the walls of the nest hole. There was no obvious dung or food debris present. The insects included 86 adults and 37 nymphs of the plant bug *Chilocoris laevicollis* (Fam. Cydnidæ). No explanation of the member of a phytophagus family breeding in the nest can be offered. Beetles of the family Carabidæ were represented by two examples of *Oecornis nidicola* gen. et sp. nov. and 15 larvæ possibly of the same species: 15 elaterid larvæ also occurred and 35 larvæ of a species of, or near to, Alphitobius (Tenebrionidæ). Lepidoptera was represented by 201 larvæ of the family Coleophoridæ. Also, there were 43 nymphs of a new species of Blattidæ and four acalypterate fly larvæ. It is noteworthy that at least seven of the eight species found in the nest were breeding there, and it is concluded that the thoroughly sanitary state of the nest must owe much to their scavenging activities.

Echinoderms from the John Murray Expedition

Two recent reports deal with the Regular Echinoidea and the Ophiuroidea respectively (John Murray Expedition 1933–34, *Sci. Rep.*, 6, No. 1. "Report on the Echinoidea of the Murray Expedition", Part 1. By Th. Mortensen; and 6, No. 2. "Ophiuroidea". By Hubert Lyman Clark. British Museum (Natural History), 1939). There are 35 species of regular Echinoidea collected by the Expedition, less than those obtained by the *Investigator* (50 species), but with regard to the Cidarids it has done even better, for out of 12 species, 5 are new, one representing a new genus. Moreover, two of these, *Cidaris mabahissæ* and *Lissocidaris fusca*, are of great zoo-geographical interest as they belong to the sub-family Cidarina, hitherto only known from the Atlantic. *Goniocidaris indica* is also a very interesting discovery as the genus, so richly developed in the Japanese-Malayan-Australian region, is not otherwise represented in the Indian Ocean. A discussion of the zoo-geographical problems will be included in Part 2 of this report. The Ophiuroids form a splendid collection from the North West Indian Ocean. It is very rich in genera and species, there being six new genera out of 42 obtained and out of 102 species one third are new. All are very distinct forms. The numerous illustrations are very clearly drawn and show the essential features. From the study of the *Mabahiss* material it is shown that the ophiuran fauna of the Arabian Sea and adjoining coasts has undoubtedly originated from the East Indian Region but has not yet developed nearly so rich a littoral group and there is a markedly large proportion of endemic species.

Garden Plants of the Future

MANY plants of potential garden beauty lie in static conservation within herbaria. F. Kingdon Ward, though himself responsible for numerous exsiccata, has made a survey of such conservatories in order to discover horticulturally deserving plants which have not yet been aligned with garden practice. A few of these have recently been described (*Roy. Hort. Soc. J.*, 65, Pt. 5; May 1940). *Vaccinium modestum, Laccopetalum giganteum, Arctomecon californicum,* two species of *Veronica, Rhododendron Devriesianum, Gentiana setulifolia* and *Limonium insigne* are but a few botanical examples of world-wide origin, which have not yet enjoyed the care of the cultivator. Captain Kingdon Ward's descriptions, however, show that gardens would indeed benefit from their introduction, and this experimental invasion of 'botanical mausoleums' might well be extended.

Apomixis in Crepis

G. L. Stebbins and E. B. Babcock (*J. Hered.*, 30, 519–529; 1940) and G. L. Stebbins and J. A. Jenkins (*Genetica*, 21, 191–224; 1939) describe the behaviour of several North American species of Crepis. These species are polymorphic, have variable and high chromosome numbers, and are apomictic. Within the group of species studied, only seven were diploid and sexual and considerably restricted in geographic range. The polyploid forms either simulate the diploid form very closely, and are presumed to be auto-polyploids, or combine the characteristics of two or more diploid forms. The apomictic forms are either obligate or facultative, and reproduce by somatic apospory followed by parthenogenesis as in Hieracium (Rosenberg). The origin and spread of the polyploid forms are described. It is suggested that apomixis accompanies hybridization and polyploidy, but is not caused by either. The origin of apomixis is suggested to be related to genetical or factorial causes. The apomictic forms sometimes produce progeny by sexual means, and thus secondary types are evolved. As these authors and Banta (*Proc. Gen. Soc. Amer.*, 1939) point out, the apomictic-amphimictic life-cycle greatly favours the rapid spread of variants. Hence it is found that there is great polymorphism as one leaves the region of the diploid progenitors. Occasional crossing between an allo-polyploid and a third diploid species will also increase the variation.

Male Sterility in Hebe

IN a population of 2,200 plants of *Hebe traversi* at Cass, New Zealand, 3·5 per cent of the plants were found to be pollen sterile. O. H. Frankel (*J. Genet.*, 40, 170–184; 1940) also found wild plants of other species of Hebe to be pollen sterile. Cytological study showed that the chromosomes of male sterile *H. parviflora* and *H. subalpina* collapse into an amorphous mass following pachytene. In *H. salicifolia* var. *communis* all stages are normal until telophase II, but no tetrads were seen. In *H. leiophylla* × *H. salicifolia* and in *H. traversi* pollen grains degenerate very soon after formation and before the cell walls thicken, whilst in *H. Townsoni* an upset of timing of meiosis in the anther is present together with signs of collapse of the pollen grains. It is suggested that some major physiological disturbance affects the loculus at a time characteristic of the particular male sterile form.

Irregular Flowers in Phlox

J. P. KELLY (*J. Hered.*, 31, 169–171; 1940) bred from an individual of Phlox the flowers of which lacked one or more petals. The characteristic was inherited, but great fluctuation in the proportion of irregular flowers was found. In an F_1 hybrid between regular and irregular flowered plants, 147 were regular and 10 slightly irregular. The F_2 segregated 808 regular : 197 irregular. Other data show that the fluctuation in irregularity is environmental in origin.

Core Disease in the Apple

H. P. BELL has published an interesting note on the susceptibility of the Gravenstein apple to core disease (*Canadian J. Res.*, 18, No. 3; 1940). Harrison has previously suggested that the "constitutional weakness of the calyx end" was responsible for the prevalence of this trouble in the variety, and Prof. Bell's observations confirm this suggestion. The carpellary cavities are usually closed from the stylar cavities by solid tissue in the intervening region, which might be described as at the upper level of the calyx tube. In the Gravenstein, however, cavities in the radial stylar extensions continue to penetrate very deeply into this tissue, much more deeply than in other varieties studied. Thus this tissue organization is structurally weaker at this calyx end of the apple, and radial fissures may easily develop and facilitate the entry of disease to the carpellary core.

Radio Echoes and Fading

J. A. Pierce and H. R. Mimno (*Phys. Rev.*, 57, 95) point out that the records of signals reflected vertically by the ionosphere sometimes show an anomalous distribution of intensity among the successive reflections; for example, highly multiple reflections may be as strong as, or stronger than, the first two or three reflections. This condition may persist for ten minutes or so at a time, and the authors explain it by supposing that the ionospheric layers show local curvature which focusses the waves on the receiver after a certain number of reflections. These effects are only observed when transmitter and receiver are close together, and have no effects in normal radio communication. It is probable, however, that focussing by reason of changes of curvature in the F layer may affect communication over distances comparable with the radii of curvature, of the order of thousands of kilometres, and the authors discuss cases of slow cyclic fading in trans-Atlantic short-wave signalling which may be explained in this way. Sunrise must be associated with considerable slope and curvature of the surface of the ionospheric layers, and in fact the focussing phenomena have been observed at this time. A mechanism is indicated which leads to the reflection of rays back to the transmitter by a complicated path at such a region of curvature, and may lead to the production of echoes of very long delay of the order 0·1 sec. A similar suggestion of local irregularities was put forward some years ago by G. R. Toshniwal, B. D. Pant, R. R. Bajpai and B. K. Verma (*Proc. Nat. Acad. Sci., India*, 6, 161 ; 1936).

Field Produced by a Linear Radiator

A paper by F. M. Colebrook, of the National Physical Laboratory, has been communicated to the Institution of Electrical Engineers (*Journal*, Feb. 1940), on the electric and magnetic fields of a linear radiator carrying a progressive wave. The vector- and scalar-potential method of calculating electric and magnetic fields is applied to a straight conductor carrying a progressive wave of current. The author proves that unless the conductor is assumed to be terminated by charges which satisfy the condition of electrical continuity at the ends, the calculated field has an anomalous and impossible character. Such charges need not be included in the case of closed circuits of conductors carrying progressive waves. He confirms this by analysing in a special case the mutual cancellation of the anomalous features. It is pointed out that a linear progressive wave radiator has only one axis of symmetry, which is that of the radiator itself. This differs from a standing wave radiator which is symmetrical about the equatorial plane. Analysis thus confirms the asymmetry of the field from a progressive wave radiator. The field system associated with a progressive wave of current is regarded as a more fundamental conception than that due to a standing wave, since any standing wave system of currents is resolvable into positive and negative travelling waves. This feature is illustrated by the synthesis of the travelling wave fields into the known form for a dipole standing wave radiator. The radiation resistance of a progressive wave radiator is calculated by Pistolkoro's method, and is shown to be equal to that for a standing wave radiator when the length of the radiator is an integral number of half wave-lengths.

Electron Microscope

The RCA Manufacturing Co., Camden, N.J., U.S.A., announces the production of a new electron microscope developed in their research laboratories by Drs. L. Marton and V. K. Zworykin. The instrument, like that described by Martin, Whelpton and Parnum (*J. Sci. Inst.*, 14, 14 ; 1937), employs the magnetic lenses, the optical equivalents of a condenser, objective and projector. The intermediate, or first-stage image, is produced by the objective at a magnification of 100 diameters. This image is subjected to a further magnification of 250 by the projector lens, which throws the final image at a magnification of 25,000 on to a fluorescent screen for direct observation or on to a photographic plate. The quality of the photographic record of the final image is such that a further optical enlargement of 4 diameters may be used, giving a total overall useful magnification of 100,000 diameters. The technique of preparing specimens for examination has been carried to a stage where the instrument is ready for use in a research laboratory. Examples of the application of a similar instrument to biological investigation have recently been given by von Ardenne (*Naturwiss.*, 8, 113–127 ; Feb. 23, 1940) who has photographed such objects as diatoms, viruses and bacteria at magnifications up to 100,000. The development of the instrument has opened up a new field to direct observation hitherto far beyond the resolving power of the optical microscope. The size and shape of smoke particles and the changes during the reaction of small particles with a gas are susceptible to direct visual observation. The use of the instrument promises to yield much new knowledge about particles of colloidal dimensions.

Energy of Gaseous Molecules

The calculation of the fraction of the molecules in a gas which possess energy above a specified amount is simple when motion in only two directions is considered but becomes difficult when three directions are considered. Hence in many cases the simple form for motion in two dimensions has been used in cases where three dimensions are involved. A. H. Heatley (*Canadian J. Research*, 18, 123 ; 1940) has given a table of a function from which the ratio, v, of the fraction N_1/N (N is total number of molecules, N_1 is number of molecules possessing energy greater than E for the two-dimensional case ($N_1/N = e^{-E/RT}$) to the ratio for the three-dimensional case) can be calculated. This ratio is equal to $[2x^2 + L(x)]/x\pi^{1/2}$ where $x^2 = E/RT$ and $L(x)$ is a tabulated function, the relations of which to the error function complement and other functions are given. It is shown that the ratio v changes rather slowly as E/RT changes :

E/RT	0	1	4	9	16	25	36	49
v	1·00	1·56	2·51	3·56	4·65	5·73	6·86	7·98

Properties of 3 : 6-Anhydrogalactose

The transformation of an α-methylglycoside or a β-methylglycoside into an equilibrium mixture of the two forms may be effected by means of methyl-alcoholic hydrogen chloride, and it is usually accepted that this transformation involves the intermediate formation of the free sugar. W. N. Haworth, J. Jackson and F. Smith (*J. Chem. Soc.*, 620 ; 1940) have now described the syntheses of 3 : 6-anhydro-α and β-methylgalactopyranosides and various methylated derivatives. Liquid 2 : 4-dimethyl 3 : 6-anhydro-α-methylgalactopyranoside can be directly transformed into crystalline 2 : 4-dimethyl 3 : 6-anhydro-β-methylgalactopyranoside by small amounts of hydrogen chloride in air, hydrogen bromide in air, ethereal hydrogen chloride, ethyl-alcoholic hydrogen chloride and methyl-alcoholic hydrogen chloride. The direct isomerization of α to β also occurs spontaneously when the α-form is kept for several months. None of these methods appears to involve the intermediate formation of a free reducing group. With excess of methyl-alcoholic hydrogen chloride both the α- and β-form of 2 : 4-dimethyl 3 : 6-anhydromethylgalactopyranoside, which have strained structures, yield the relatively strainless 2 : 4-dimethyl 3 : 6-anhydrogalactose dimethylacetal. Hydrogen chloride or hydrogen bromide effects the removal from this of the elements of methyl alcohol, and 2 : 4-dimethyl 3 : 6-anhydro-β-methylgalactopyranoside is produced. It is suggested that the steric effect of the stable 5-membered 3 : 6-anhydro-ring is responsible for some of the peculiar properties of 3 : 6-anhydrogalactose and its derivatives.

AGEING OF POPULATIONS

PROF. RAYMOND PEARL'S presidential address at the centenary celebrations of the American Statistical Association on December 29, 1939 (*J. Amer. Statist. Assoc.*, 35, 2; 1940), points out that populations indubitably age with time, and as a relevant example compares certain aspects of the population of the United States one hundred years ago and the population of to-day in those areas which formed part of the States one hundred years ago.

Notwithstanding the partiality of poets and other writers for the seven stages of man's life, biologically the life-cycle of any mammal falls into three stages, and three stages only, which have epistemonic significance. These are pre-reproductive, reproductive, and post-reproductive. In man the pre-reproductive stage includes infancy and the major part of growth. The reproductive phase is *also* the period of full vigour in all the manifold ways that the human engine uses to let off steam. The post-reproductive phase is *also* the period of senescence, and of the ripened wisdom that only the experience of living a long time can bring. Mostly these matters biologically are *also* secondary to the basic business of life; one of them, however, is of first-rate importance, especially in the human animal, namely, that people in the reproductive phase have to do the work not only to get their own livings, but also the livings of the young and the major part of the livings of the old in the post-reproductive phase. This puts a heavy burden of work on the shoulders of a moiety of every human population that we know anything about.

From this consideration arises a threefold age classification of 0–14 years, 15–49 years, and 50 years and above, allocating the population in substantial accord with the fundamental biological divisions of each individual human being's life-cycle from birth to death. About 50 per cent of all populations, it has been noted, fall into the 15–49 class, but in the other two classes the numbers vary more widely and in a compensatory way. Thus a population like that of India in 1931 had 39·9 per cent in the pre-reproductive phase, 50·4 per cent in the reproductive phase, and only 9·7 per cent in the post-reproductive phase. In the same year, by way of contrast, the population of France had only 22·9 per cent in the pre-reproductive phase, abou[illegible] 51·4 in the reproductive phase, and almost three times as great a proportion, 25·7 per cent, in the post-reproductive phase. Biologically the two populations are deeply differentiated.

It is clear that the status of any population at a given moment relative to the proportions of its component members, falling in the three biological phases of the life-cycle, may have an important and direct bearing upon the aggregate or composite behaviour of that population and upon the probable course and outcome of any enterprises upon which it may embark as a whole. Of all the forms of aggregate behaviour in which a population may become involved, war is one of the most significant as well as dreadful. Comparing the populations of the chief protagonists in World War I of 1914 and World War II of 1939, taking Germany and Austria in 1914 as opposed to France, England and Wales, Scotland and Belgium, but omitting Russia for certain reasons, as well as outlying parts of the British Empire, on the figures of 1910–11, Germany and Austria had resources of upwards of 64 million persons, of whom approximately 33·5 per cent were in the pre-reproductive phase, 50·8 workers of the reproductive phase, upon whom fell the burden of fighting and producing goods for the troops and civilian population, and 15·7 were over 50 years of age; or taking male population only, 34·1 per cent, 51·3 per cent and 14·7 per cent respectively. Among the Allies the corresponding figures were a total population of 87·5 millions, of whom 52·2 per cent fell in the fighter-worker class, representing an actual advantage of nearly 3 million persons. In the under 15 phase were 28·5 per cent, and over 50 years about 19·3 per cent. Taking male population only the Allies numbered upwards of 48 millions against 32 millions for Germany and Austria, a relative advantage of 34 per cent. Of its components 52·4 per cent fell in the fighter-worker phase as against 51·3 in the German controlled population resources.

At the outbreak of World War II, the Allies had total population resources of both sexes of 87 million persons, of whom more than one quarter (as against 19 per cent in 1914) were of post-reproductive age. Further, instead of 52·2 per cent of fighter-workers, there are only 51·3 per cent in this phase. Finally, instead of 28·5 per cent of youngsters coming of age there are only 23·6 per cent.

The population resources controlled by Germany (including Czechoslovakia) in September 1939 present a different picture. She has a total of approximately 90 millions to draw upon. Of its component members 53·7 per cent, as against the Allies 51·3 per cent, were in the fighter-worker phase, representing an advantage of more than 3·6 millions of persons, of whom a little fewer than half are males, while there are only 22·4 semi-dependent old folks as against the Allies 25·2 per cent, while of youngsters there are 23·8 as against the Allies 23·6 per cent. It is plain that so far as the population aspects of war are concerned, the absolute and relative advantages and disadvantages accruing from that source have become reversed in the quarter of a century separating these two great conflicts. Falling birth-rates on one side and rising birth-rates on the other have been in the main responsible.

Prof. Pearl went on to analyse in similar manner the white population statistics for thirty political subdivisions of the United States in 1840 and 1940, and arrived at the main conclusion that while the old folks on one hand and the youngsters on the other are "ganging up" on the half of the population [illegible]at does the work, pays the bills and taxes, and in cold fact earns the living for all, whereas in 1840 each 1,000 workers had 1,084 other persons, younger and older, to take care of, in 1930 each 1,000 of the 44,134,796 workers supported only 880 persons besides themselves. Biologically this appears to be a striking example of *adaptation* of the human species, *qua* species. The current use of such devices as contraception (or, for that matter, capitalism or communism) as adaptive procedures to ease the burden of ageing populations may in the long run be the moral equivalent of curing a toothache by the effective but disastrous technique of cutting off the patient's head. It is no good making life easier if there is no one to live it.

IRRIGATION RESEARCH IN THE PUNJAB

A MODERN aspect of irrigation has been given prominence by the recent publication of the report of the Punjab Irrigation Research Institute for the year ending April 1938.[*]

The report is a record of considerable activity and success in dealing with the great direct and indirect problems associated with the large-scale irrigation of an alluvial countryside. During the year there were added to the facilities of the Institute a new Hydraulic Laboratory and a River Research Station at Malikpur, but even with these the pressure of the demand is unabated, for the growing recognition of the importance of soil studies has resulted in an increased volume of work.

The staff of the Institute is divided into seven different sections to deal with the several classes into which its work may be assorted. In the Chemical Section, perhaps the most important investigation was that on the reduction by chemical means of seepage losses from canals, which has now reached the field stage. Here the result of treating the bed of the Awagat Distributary with a lining of soil impregnated with sodium chloride was to reduce the seepage by 2·3 cusecs, and this at a cost which it is calculated will be paid for by the additional revenue from the water saved over a period of three years. This Section has also been investigating the movement of salts in the soil profile, which in the Punjab alluvium consists of a shallow soil crust overlying sand. With a rising water-table the salts move towards the surface and form an accumulation ; from intensive examination of a small area it was determined that there is no lateral movement of the salts and their rise at any point depends mainly on local characteristics and on the factors causing the rise. The work in the standardization of methods has resulted in a simple procedure for estimating total sulphides in soils and irrigation waters and in the determination of the isohydric pH value of soils, both of which are explained in the report.

The chief study which has engaged the Physics Section was one on tube wells in model, and was directed towards determining the factors which influence discharge. The conclusions pointed to are threefold, it being found that, subject to certain provisos, the yield is generally proportional to the draw-down and increases very slowly with increase in the diameter of the strainer, while it can also be increased by shrouding. Other investigations in this Section were concerned with the problem of seepage from canals, with the transmission constant of sands and with silt in relation to regime conditions. Experiments were begun in the Laboratory to examine the capillary rise in soils, and particulars of the method and apparatus in use are given.

Relationships between the bed silt and the hydraulic elements of channels have been investigated by the Statistical Section, and the empirical results obtained have already been found useful in the running of old channels and the design of new ones. Although they are not put forward as of general application, the suggestion is made that they should be tested on canal systems outside the Punjab. The most important work of the Hydraulic Section was provided by the Haveli Project in the reconditioning of works and river training operations. Laboratory investigations were made in order to get a design for the Trummu Weir which would give maximum coefficient of discharge, and the falls to be constructed on the canals have been exhaustively studied.

At the River Research Station at Malikpur a model was made of the Rivers Chenab and Jhelum at their confluence, and the work done on this has led to precautions being taken which will reduce to a minimum difficulties which have been met in earlier constructions of this nature. An interesting point arising from the Land Reclamation Section's report is the tendency of cotton land to deteriorate, while that irrigated for rice gives a more permanent form of reclamation.

---

[*] Punjab Irrigation Research Institute. Report for the Year ending April 1938. Pp. vii+156+84 pl. (Lahore.)

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

IN the account of the Congress of the South-Eastern Union of Scientific Societies held at St. Alba[illegible] last year, printed in NATURE of July 8, 1939, it was suggested that this year the usual five-day Congress might be held in Cambridge and, as supplementary to the main annual Congress, single-day meetings might also be arranged to help local societies in centres too small to justify selection as a meeting place. The effect of war conditions, however, has ruled out Cambridge for the present. Following the precedents set in 1917 and 1918, therefore, for general convenience the abbreviated Congress was held in the rooms of the Linnean Society in London on June 12.

In the morning the Sections held their business meetings, independently, each being followed by an address and discussion. The addresses will appear later in an abbreviated volume of the *South-Eastern Naturalist and Antiquary* (vol. 45) and were as follows : archæological address on "Medieval Towns" by Mr. G. E. Chambers ; botanical address on "Seaweeds and their Uses" by Dr. E. M. Delf ; geological address on "Hints on Geological Mapping" by Dr. R. L. Sherlock ; and, in the afternoon, zoological address on "Waterfowl" by Mr. D. Seth-Smith.

The new president of the Union, Dr. R. R. Marett, Rector of Exeter College, Oxford, delivered his address on "Realism and Idealism in the Study of Man". Anyone who has read Prof. H. L. Hawkins's 1938 Alexander Pedler lecture on "Humanity in Geological Perspective", given at the Worthing Congress, will recognize that both treat of the same general theme, but from different angles, and arrive at the same conclusions. Dr. Marett's main point was that a philosophy and a science of man must come to terms; in other words, that any doctrine of human perfectibility should have regard for man's place in Nature as the anthropologist seeks to determine it. The conditions of survival must be observed if a given people, or the race as a whole, is not to be improved clean off this planet.

True, the human species for the moment enjoys a biological dominance scarcely challenged unless it be by the bacteria; so that man's greatest foe is, roundly speaking, himself. Even so, it would not take the race long to breed up to the extreme limit of bare sustenance; and to-day those who desire not merely to live but to live well, in short, the representatives of the higher culture, are elbowing entire peoples of backward culture out of existence. A survey of the world's potential food supply shows that mankind has already exhausted much of its heritage by failure to attend to the principles of soil conservation; nor can all the brilliancy of city life atone for neglect of the land, since a city population, despite the diversity of its arts, is somewhat overcrowded and is too near the hunger line to offer any security to the improvident. Physical anthropology has no knowledge of any chosen people, or of racial limitations of intelligence, that would prevent the exchange of ideas between men whose minds, like their tongues, have acquired a catholic function.

A bulletin (No. 75) issued for the Congress outlined the research work being carried out by the affiliated societies independently: it includes archæological excavations at Highdown Hill, Sussex, the application of science to animal welfare, ecological research at Limpsfield Common, observation of insect immigration, and the preparation of various lists of local flora and fauna upon the plan suggested by the Association for the Study of Systematics in Relation to General Biology. Certain centres where future congresses are likely to be held are preparing the material for the issue of local survey volumes, on the plan advocated by the British Association, in a uniform edition of which those for Hastings and Worthing have already been published under the title "A Survey of Times Past and Present" (3s. 6d. net).

The annual report of the Insect Immigration Committee shows that by placing more reliance upon individuals keeping daily observation on schedules issued in each county, it will be possible to continue to collect records despite war conditions. The year 1939 was remarkable for the immigration of Large and Small White butterflies in southern England the larvæ of which ravaged market gardens more extensively than for the past twenty years; but as so large a percentage of the larvæ were parasitized, pest conditions are not expected to result this year. In France some 10 per cent damage was done by Painted Lady butterflies to globe artichoke plantations, but heavy rains practically wiped out the larvæ and only 4,500 butterflies of this species were recorded in the British Isles. Before May 1, 1940, the unusually large number of ninety Painted Lady butterflies were recorded, which either indicates a very early immigration from warmer climes or that the species can tolerate a dry winter, however cold, by hibernation like our Small Tortoiseshell.

The Congress hopes to meet next year in Brighton.

T. D.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING—The Registrar, College of Technology, Manchester (July 9).

ASSISTANT LECTURER IN ENGINEERING (MECHANICAL)—The Registrar, The University, Manchester 13 (July 13).

WORKSHOP INSTRUCTOR FOR ENGINEERING WORKSHOP PRACTICE AND WOODWORK, and a GRADUATE IN ENGINEERING OR SCIENCE TO TEACH MATHEMATICS AND SCIENCE, at the Schofield Technical Institute, Mexborough—The Secretary to the Managers, West Riding of Yorkshire Education Department, Education Office, Mexborough (July 13).

ASSISTANT TO THE ADVISORY OFFICER IN ANIMAL HUSBANDRY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (July 15).

PROFESSOR OF VETERINARY SURGERY, OBSTETRICS AND ANIMAL HUSBANDRY at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45, Upper O'Connell Street, Dublin (July 30).

PROFESSOR OF OBSTETRICS in the University of Sydney—The Secretary, Universities of the British Empire, 88a Gower Street, W.C.1 (September 30).

DIRECTOR OF SOCIAL STUDIES—The Registrar, University of Sydney, Sydney, New South Wales, Australia (September 30).

GRADUATE LECTURER IN MECHANICAL ENGINEERING at the Royal Technical College, Salford—The Acting Director of Education, Education Office, Chapel Street, Salford 3.

LECTURER (GRADE II) IN THE FACULTY OF ENGINEERING—The Secretary, University College, Gower Street, W.C.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich. Pp. 26. (Greenwich: Royal Observatory.) [46

Department of Scientific and Industrial Research. Report of the Building Research Board; with the Report of the Director of Building Research for the Year 1939. Pp. iii+60. (London: H.M. Stationery Office.) 1s. net. [106

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 9: Harmonic Riemannian Spaces. By E. T. Copson and H. S. Ruse. Pp. 117–133. 1s. 6d. Vol. 60, Part 1, No. 10: Interpolated Derivatives. By Dr. B. Spain. Pp. 134–140. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [106

Other Countries

U.S. Department of Agriculture. Circular No. 554: Honey and Pollen Plants of the United States. By Everett Oertel. Pp. 64. 10 cents. Technical Bulletin No. 716: Investigations on the Physical and Chemical Properties of Beeswax. By Charles S. Bisson, George H. Vansell and Walter B. Dye. Pp. 24. 5 cents. Technical Bulletin No. 721: *Paradexodes epilachnae*, a Tachinid Parasite of the Mexican Bean Beetle. By B. J. Landis and N. F. Howard. Pp. 32. (Washington, D.C.: Government Printing Office.) [36

Proceedings of the United States National Museum. Vol. 88, No. 3085: Two New Genera and Three New Species of Cheilodipterid Fishes, with Notes on the other Genera of the Family. By Leonard P. Schultz. Pp. 403–424. Vol. 88, No. 3086: A Contribution to the Knowledge of the *Eucharidae* (Hymenoptera: Chalcidoidea.) By A. B. Gahan. Pp. 425–458. Vol. 88, No. 3089: Notes on the Birds of Kentucky. By Alexander Wetmore. Pp. 529–574. (Washington, D.C.: Government Printing Office.) [36

Transactions of the San Diego Society of Natural History. Vol. 9, No. 16: A Race of the Warbling Vireo from Guerrero, Mexico. By A. J. van Rossem. Pp. 77–78. Vol. 9, No. 17: Notes on some North American Birds of the Genera Myiodynastes, Pitangus and Myiochanes. By A. J. van Rossem. Pp. 79–86. Vol. 9, No. 18: The Worm Snakes of the Genus *Leptotyphlops* in the United States and Northern Mexico. By Laurence M. Klauber. Pp. 87–162+plate 6. Vol. 9, No. 19: The Lyre Snakes (Genus *Trimorphodon*) of the United States. By Lau[illegible]ce M. Klauber. Pp. 163–194+plate 7. Vol. 9, No. 20: Two New Subspecies of *Phyllorhyncus*, the Leaf-nosed Snake, with Notes on the Genus. By Laurence M. Klauber. Pp. 195–214. (San Diego, Calif.: San Diego Society of Natural History.) [36

Contributions from the Biological Laboratory of the Science Society of China, Zoological Series. Vol. 13, No. 5: Study of some Forest Insects of Nanking and its Vicinity, Part 3: Observations on the Gypsy Moth (*Porthetria dispar* L.). By C. P. Miao. Pp. 57–78. Vol. 13, No. 6: Succinate Oxidation and the Inavailability of the Energy derived therefrom for the Activity of Frog Muscle poisoned with Iodoacetic Acid. By T. H. Chang and T. T. Yu. Pp. 79–86. Vol. 13, No. 7: A Note on the Vitamin C Content of some Dried, Sugared and Salted Chinese Vegetables and Fruits. By Libin T. Cheng and H. Tao. Pp. 87–90. Vol. 13, No. 8: A Dietary Study of the Middle-Class Chinese and Mohammedans in Sungpan. By Libin T. Cheng and Hsuo-Chi Ku. Pp. 91–100. (Shanghai: Science Society of China.) [36

Collected Papers from the Faculty of Science, Osaka Imperial University. Series C: Chemistry. Vol. 6, 1938. Pp. vi+35 papers. (Osaka: Osaka Imperial University.) [66

Regenwaarnemingen in Nederlandsch-Indië, 1937. Pp. 131. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [66

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, JULY 13, 1940 No. 3689

DEPT. OF APPLIED CHEMISTRY
CAL. UNIV. LIBRARY

THE FUNCTION OF THE PRESS

AN important declaration of policy was made by the Lord Privy Seal, Mr. Attlee, on July 3, in answer to a Parliamentary question regarding the liberty of the Press. He said:

"The policy of the Government is to interfere as little as possible with the liberties of the Press to express freely their opinions and comments on the conduct of the war or on supposed peace overtures." He pointed out, however, that information useful to the enemy can be included in statements that appear to be opinion only, and that the Government was not prepared to undertake not to interfere with such statements.

The question and answer came as a sequel to a number of comments in the daily Press which seemed to indicate that an extension of the present method or scope of censorship was imminent, and they will reassure public opinion to some extent. In these critical days, it cannot be denied that a measure of censorship is necessary. On the other hand, one of the fundamental issues of the conflict is the right to freedom of the Press, freedom of speech and thought for the individual. How can these contradictions be resolved? Under the present system, editors of journals are responsible for seeing that nothing likely to be of use to the enemy is published by them. When doubt arises, the matter can be submitted to official censorship. On the whole, the method has worked well. The Press in Great Britain has grown up in an atmosphere of free discussion, and it recognizes the need for the present restrictions in the interests of the welfare of the country and the cause to which we are committed. It is not prepared, however, to accept interference with its long-established function of criticism of policy and action.

So far as the lay Press is concerned, the question of censorship is concerned mainly with the publication of news in letterpress and pictures of events, of weather conditions and similar information, much of which, if not carefully weighed, would be of considerable value to the enemy. The technical Press is somewhat differently affected. Among other matters, a strict watch has to be kept so that information as to the location of new industries is not disclosed, and industrial developments or progress must obviously be treated with caution.

In NATURE, the problem is different again. All scientific advances can be regarded as possibly of service to the enemy; but to follow this line of action literally would be tantamount to suppressing the diffusion of knowledge. In consequence, all communications submitted for publication in the correspondence columns of NATURE are examined carefully from this point of view and in the light of knowledge of current events; and the Editors have not hesitated to take further advice when an element of doubt has seemed to be present. Many contributors are themselves doing work of national importance, and they should know at once whether their results ought or ought not to be published. On the other hand, many others whose duty it is to carry on their normal work, will naturally wish to inform their fellows of results obtained. They should then ask themselves whether their work is likely to have practical applications which might be of service to the enemy.

Another function of NATURE is to keep scientific workers and others informed by means of descriptive articles of the progress made in selected subjects. Here again the needs of the times have to be borne in mind, and in addition to surveys of progress, NATURE is publishing articles dealing with topics of immediate importance, such as those now appearing on various aspects of the utilization of waste materials.

It is, however, in the matter of leading articles and critical notes that NATURE is perhaps most deeply concerned in the freedom of the Press. A rigidly controlled Press is a characteristic feature of totalitarian rule, echoing with fulsome monotony the official view. It is equally characteristic of the democratic system that officialdom is open to criticism, out of which comes further progress. This is the particular 'freedom' for which a journal such as NATURE must stand; not the freedom to make malicious attacks on the policy of Government, but the freedom to make constructive criticism in order to promote the cause we all have at heart. It is a hardly won privilege, which we have used, and shall continue to use, with a keen sense of responsibility.

SCIENTIFIC METHOD IN ADMINISTRATION

THE willingness and cheerfulness with which the whole nation has accepted the drastic restrictions now being placed on civilian supplies and the use by the Minister of Labour and National Service of the wide powers of control which he now possesses over labour and industry, are a measure of the determination of the British people to continue the struggle for freedom in the world. The magnificent response of labour to Mr. Bevin's appeal indeed shows that the people of Great Britain have shed any lingering illusions as to the magnitude of the effort demanded of them all, but it would be unfair to place all the responsibility for this apparent change on the dramatic swiftness with which the tide of war has rolled towards our own shores since the invasion of the Low Countries and France. Part at least of the response is due to a leadership for which many had been impatiently waiting for months.

The changes and effort involved in the transference from a peace-time to a war economy have been reviewed in a number of admirable broadsheets issued by P E P (Political and Economic Planning), notably under the titles "The Home Front" and "Industrial Man Power", and the second of these broadsheets reviewed the position up to the recent change in Government. Since then we have moved much nearer to a full war economy. It has become a matter of life and death that the habits and customs of a *laisser-faire* society should be abandoned, and the economic and social implications of modern warfare be fully recognized. Just as the new order gives the Minister of Labour full and drastic powers over every man and woman in the land to ensure the most effective use of the nation's resources of man- or woman-power, so the new rationing order limiting supplies to home consumers, issued by the Board of Trade, supplies the power to check any who are still reluctant to curb their own private requirements at a time of national need.

Fully as significant, however, as the evidence that these developments afford that the Government possesses a definite economic policy and the vision and vigour to elaborate it into the detail required, is the fact that they have been gladly accepted by a nation which was indeed largely impatient for them. For that, as we have said, credit must be given to wise and imaginative leadership, alive to the necessity of education in a constructive enterprise of this magnitude. By taking the people into its confidence, the Government kindled their imagination and paved the way for the magnificent response which in due course will enable us to wrest the initiative from the enemy, and bring final success to our efforts.

Neglect of such educational work has been an important factor in the failure of the earlier evacuation schemes for school children, and there are still many fields such as rationing, the restriction of private purchases, and civil defence, in which educational work is still required. This may well be one of the directions in which the Ministry of Information may make important contributions. With such education, there must go the utmost diligence to see that the full purpose of the new efforts is not impeded by vested or private interest of any kind. Nothing can be tolerated which is liable to endanger confidence in the impartiality or integrity of our leadership; this has special significance in considering the restriction of certain forms of sport or pleasure or of the production of some types of foodstuffs or beverages.

We are none the less entitled to the conclusion that in these difficult and anxious days, we have now a Government which is in advance—even if only a little—of public opinion, and not far behind it in its ideas of the sacrifices and effort that must be made, and made at once. This fact and the opportunities thereby opened up constitute at least one reason for hope in a desperate situation. If our present intense effort is wisely and effectively organized, we can gain the time and opportunity, as the full power of our resources is brought into play, to deal with those many interlocked problems not merely of a war economy but also of reconstruction after the war. We have at least come within sight of leadership of a quality competent not merely to organize effectively our resources for war but also to use wisely the immense opportunities which the catastrophe of war gives us of overthrowing obstacles which have impeded the development of society in time of peace.

It is well that this question of reconstruction should remain in our minds even at this critical hour, for many of the problems with which we are now dealing urgently are vitally related to them, and it may well be that the solutions to some of our longer range war problems and those of reconstruction may be found on similar lines. The immediate problems involved in the most efficient use of our man-power have their bearing on the unemployment problem, the magnitude of which after the War may well be determined by the lines on which our labour problems are now handled. Measures affecting the mobility of labour, its training in new types of skill, the neglect or encouragement of technical education, and the care taken in regard to training in safety methods or the safeguarding of health, whether in respect of hours of work, or factory or workshop conditions such as lighting, ventilation or the like, may have as a significant influence on the morale and adaptability of the industrial population after the War as on the efficiency of our immediate war effort.

That the Ministry of Labour has taken over from the Home Office the whole administration of the factory, including the health and welfare provisions, and that the Factory Department of the Home Office is now incorporated for the duration of the War in a new department of the Ministry of Labour called the Factory and Welfare Department, are signs that concern with the short-range problems of immediate intensive production will not lead to those of a long-range policy being overlooked. Steps have also been taken, at long last, to facilitate the development of a food policy based on scientific knowledge and control ; in no other field could a scientific policy have more far-reaching and beneficial effects both after as well as during the War. The building industry and the shipping industry are two further examples where policy or machinery established during war-time must have far-reaching repercussions on recovery.

If there are thus signs not only of energy but also of the forward-looking mind in the leadership of the Government, there is one element in the situation which has given rise to some misgivings. In his volume "Security : Can we Retrieve It ?" published shortly before the War, Sir Arthur Salter directs attention to the desirability of strengthening the Civil Service by reinforcing its personnel, at the top with leading men in industry and science, and throughout its ranks with young men of energy and constructive ability. Sir Arthur urged that only in some such way could the present machinery of civil government become competent to deal even with the task of preparation for war, for which in some ways the Civil Servant's experience is a definite handicap to him. The importance of bringing fresh blood and new methods of training into the administrative class of the Civil Service was also emphasized by Prof. Ernest Barker in an essay in the *Political Quarterly* so long ago as 1936 and afterwards reproduced in "The British Civil Servant" edited by Dr. W. A. Robson.

Failure to implement such criticisms or suggestions has in the meantime led to widespread concern as to whether the Civil Service, and with it the local government service, is capable of taking the measure of its war-time task. To exert our maximum effort, it is not sufficient to change Ministers and Under-Secretaries and to deal justly with causes of Parliamentary inefficiency. The increasing extent to which under modern conditions the permanent Civil Service has come to control the key-points in national administration makes it essential that we should consider carefully whether, by outlook, training and technique, this machinery is competent to discharge its duties at the tempo demanded by war-time conditions.

In such an examination there is, of course, no suggestion of departure from the high traditions of integrity, capacity and devotion to duty which have given the British Civil Service its world reputation. What has to be recognized is that the Civil Service attained its position of eminence in easier and more spacious days than our own, and that the fundamental principles of lengthy examination of all proposals and minute control of expenditure, on which its work is based, operated formerly in a restricted field. There is now real danger that loyalty to these principles, good and sound in themselves, may be carried to a point which delays action where speed is essential to safeguard our very existence.

It is now generally recognized that the growing complexity of the task of national administration, in peace no less than in war, makes demands on the machinery for which training in precedent is not the primary qualification. Parliamentary government indeed depends for its efficiency upon the existence of a body of permanent officials, serving all Governments alike and preserving the continuity of stabilizing traditions. Nonetheless, it is essential that this permanent service should be characterized not merely by vigilance, integrity and loyalty to tradition, but also by receptivity to new ideas and flexibility of mind Absence of such receptivity and flexibility, it is argued, are seriously affecting our war effort.

This position is attributed not merely to defects in training, among which the absence of a scientific outlook may well be noted. It is attributed also to the destruction of ability in the War of 1914–18, which robbed the Civil Service of many who would now have been its natural leaders. It is attributed also to the tendency of policy in the last eight years to sap the vigour and integrity of public life, checking initiative and independence in the Civil Service, thus fostering the worst features of bureaucracy.

If the immediate needs of the hour are to be served no less than those of reconstruction and re-integration after the War, some means must be found immediately of redressing this situation, whether by bringing in fresh blood or giving real opportunity to the younger men of first-class ability who are undoubtedly to be found in the Civil Service. Besides the introduction of ability from outside and the extension of transfers or promotion, devolution of authority at the lower levels to hasten decision is no less imperative than changes in personnel. There is no room for inertia or for the leisurely methods of an earlier period. We must be prepared when necessary to take drastic action to secure competence and prompt and efficient administration; only thus can we hope to see the immense resources of good will and effort stirred up by the challenge of recent weeks directed into the channels which will best serve the national purpose. From top to bottom of the administrative machine, there must be an energy and drive no less intense than that which has led so many to sacrifice leisure hours, possessions and life itself at the nation's call. Coupled with it there must be a sense of values and a width of outlook which will ensure the weighing of all factors and the basing of decisions on facts no less scientifically or surely ascertained because they are determined at the same pressure and strain which the whole nation now endures. Scientific workers may well hope that changes in the Civil Service imposed to meet our immediate War needs may facilitate the speed of a scientific outlook which will lead to much more effective use being made of our scientific resources to all departments of the national life.

TOWARDS THE NEW SYSTEMATICS

The New Systematics
Edited by Julian Huxley. Pp. viii+583. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 21*s.* net.

DR. HUXLEY and his co-authors have succeeded in producing a book which makes most stimulating reading. In all, twenty-two authors have contributed a chapter each and, as mentioned in the foreword, British authors predominate, since it was felt that this would facilitate the co-ordination of the articles. Where Great Britain could not supply a suitable authority on some subject, authors of other nationalities were invited to write a chapter. Some idea of the ground covered may be obtained from a few of the chapter headings taken at random: A museum zoologist's view of taxonomy; Mutations and geographical variation; Ecological aspects of plant taxonomy; Problems of the origin of species; Polymorphism and taxonomy; The statistical consequences of Mendelian heredity in relation to speciation; Taxonomic species and genetic systems; The new systematics of cultivated plants; and so forth. Minor systematics have naturally received the greatest share of attention for the very good reason that it is the minor units which most urgently require attention, and also, as it happens, they are the most amenable to experimental analysis.

If the reader expects to find concrete suggestions for a radical revision of the present taxonomic system he will be disappointed, for the book is mainly concerned with the discussion, in the light of recent experimental evidence, of the processes which are responsible for initiating and maintaining population differentiation. In fact it provides an admirable survey of the present-day problems which confront the systematist and his colleagues in other fields of biology.

A point of particular interest to all taxonomists which emerges from this general survey is that the available evidence amply justifies the majority of species being regarded as truly biological units separated from each other largely by genetical or chromosomal barriers to free interchange of genes. Nevertheless, in certain circumstances this isolation may be broken down and a complicated system created; such a case is illustrated in Chapter iv. At a lower taxonomic level the study of micro-evolutionary processes is of equal, if not of greater importance to the systematist, for unless the variational categories are given due consideration it can scarcely be hoped to put minor systematics on a satisfactory footing. The new mathematical interpretation of the consequences of selective processes operating under different conditions has obvious taxonomic implications, and in Chapter v it is shown that random differentiation is likely to be favoured when the breeding community is very small. Examples of differentiation probably due to this cause are given in Chapter ix.

Sometimes the formation of closed breeding communities may have rather unexpected results, results which may have little or no hereditary basis. For example, although structural differentiation is not involved, the chaffinches in the southern U.S.S.R. can be distinguished "solely on the basis of variation in song, into well-defined populations each confined to a given area" (Chapter xi). In Chapter iii, however, it is pointed out that territorial fragmentation of a population is not necessarily a sure guide to the degree of isolation actually afforded to its local colonies; this gives point to the value of careful field work in connexion with taxonomic investigations. Moreover, the methods of collecting suitable samples for taxonomic work deserve much more thought than hitherto: to give only one example, for a critical examination of polymorphic populations it may be necessary to collect a series of samples over a period of years for reasons mentioned in Chapter xix.

Some biologists will, no doubt, disagree with the view expressed in Chapter xv to the effect that for a classification to be natural it must necessarily be phylogenetic. It is fairly certain that any classification involving minor units is bound to include many populations of known biological significance, but the precise 'natural' affinities of which are simply a matter for conjecture. In contrast, a natural classification is defined in Chapter xvii as one "which groups together individuals having a large number of attributes in common, whereas an artificial classification is composed of groups having only a small number of common attributes . . . both types are created by the classifier for the purpose of making inductive generalizations regarding living things". One obvious advantage of an interpretation of a natural classification in this logical sense is that it does not carry with it the implication that classifications which are not 'natural' are merely keys for convenience and thus devoid of true biological meaning.

Under the present taxonomic system it is usually possible to refer an individual specimen in terms of morphology to its proper species. This means that the species represents both a discrete morphological class and, as mentioned previously, a true biological unit. But unfortunately, as many examples throughout the book show, this coincidence of the biological unit with the morphological class by no means invariably holds. Apart altogether from the fact that some differentiated biological units possess no distinctive morphological features, there are many other instances where minor populations can only be distinguished by their different average expressions of one or more quantitative characters, or by different proportions of contrasting qualitative characters. That is, discreteness in terms of morphological discontinuity is frequently lacking. But since characters of this kind are undoubtedly valuable as guides to the biological status of populations, although not being of primary classificatory value themselves, taxonomic emphasis in such cases must be shifted from the morphological class to the population's variational category as determined by a combination of morphological, ecological, genetical and cytological investigation.

The question therefore arises: Should units, so difficult to define with morphological precision, be incorporated in the existing taxonomic system? Essential as the delimitation of minor populations is for both theoretical and economic reasons, it would be most unfortunate, as is clearly indicated in Chapter xviii, if by widening the scope of traditional taxonomy its practical functions were to be diminished in the process. The alternative is to adopt a subsidiary classification with its own distinctive terminology. Many new taxonomic categories have been proposed within recent years (a few of which may yet find a place in some such subsidiary scheme), and it is perhaps a pity that their relative merits or demerits have not been critically discussed in the present volume.

J. W. GREGOR.

GROUP THEORY

The Classical Groups

Their Invariants and Representations. By Prof. Hermann Weyl. (Princeton Mathematical Series, 1.) Pp. xii+302. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1939.) 4 dollars.

Topological Groups

By Prof. L. Pontrjagin. Translated from the Russian by Emma Lehmer. (Princeton Mathematical Series, 2.) Pp. ix+299. (Princeton, N.J.; Princeton University Press; London: Oxford University Press, 1939.) 4 dollars.

IT is convenient to review these two books together since they are complementary to each other, with a negligible overlap, and there is an interesting contrast between their characteristic features. Between them they present some of the most interesting work which has been done on groups during the last twenty years, largely by the two authors themselves, and the Princeton University Press is to be congratulated on the first two books in its new series.

The groups which are indicated by the title of Weyl's book are the full group of linear transformations, $GL(n)$, the orthogonal group, $O(n)$, and the sympletic group, $Sp(n)$, in Cartesian n-space. The co-ordinates for the latter are taken from a given field, which is subject to certain conditions, but need not be the field of real or of complex numbers. The sympletic group is what has often been called the complex group, namely the subgroup of $GL(n)$ (n even), under which a non-degenerate, skew symmetric bilinear form is left invariant.

Using the idiom of some thirty years ago—for nowadays the theory of groups, and especially the algebraic part of the Lie theory, is often included in the term algebra—these groups are studied from the algebraic point of view, rather than that of group theory. That is to say, nearly everything in the book is subordinated to a description of their algebraic invariants and representations in tensor space, as apart from their pre-eminence among the simple Lie groups. Whereas the classical theory of algebraic invariants, of which Cayley and Hilbert were the alpha and omega, was almost entirely confined to invariants under $GL(n)$, Weyl emphasizes the fact that each group has its own invariant theory. This fact, as he points out, is particularly significant in the light of Klein's description of a geometry as the theory of a transformation group. The account of invariants centres around the problem of constructing, first a basis for the rational, integral invariants of one or more vectors, under a given group, and secondly a complete set of relations between these basic elements.

As a preliminary to the discussion of representations in tensor space there is an account of linear associative algebras, with special reference to simple algebras and the commutator algebra of a given algebra. This is divided into two parts. The first contains an account of representations, and Wedderburn's theorem that any simple algebra is equivalent to a complete matrix algebra, with elements in some division algebra. The second part explains the reciprocity between the invariant sub-spaces in the regular representations of the group ring, ρ, of a finite group, and the sub-spaces which are invariant under the commutator algebra of a given linear representation of ρ. This is applied to the representations of $GL(n)$ in tensor space by taking ρ to be the symmetric group in f things, and deriving the primitive idempotents from the Young symmetrizers.

Two chapters on the representations of $O(n)$ and $Sp(n)$ are followed by what is, perhaps, the kernel of the book, namely, the chapter on characters. The characters of a given representation of $GL(n)$, $Sp(n)$ or $O(n)$ are calculated with the help of the unitary group. Two methods are given. The first is transcendental in that it involves some simple topological and analytical considerations. The second is purely algebraic and depends on the relation between the representations of $GL(n)$ and of the symmetric groups. The Poincaré polynomials for the various groups considered are given at the end of the chapter. The book concludes with second chapters on invariants and on matric algebras.

Pontrjagin's book opens with three fairly elementary chapters, one on the generalities of group theory, one on topological spaces, and one on topological groups. These are followed by a chapter on the representations of an arbitrary compact group satisfying the second axiom of countability, which is based on the construction of an abstract invariant integral over the group. It is shown that the elements of the matrices which constitute the representations, selecting one from each class of mutually equivalent representations, form a complete set of functions on the group, meaning that a suitable linear combination of these, with constant coefficients of which all but a finite number are zero, provides an arbitrarily close approximation to a given continuous function of elements in the group. The characters of the representations constitute a complete set of class functions. The next chapter presents the theory of orthogonal, commutative groups, which was developed by Pontrjagin himself in connexion with Alexander's duality theorem. It also gives a brief account of topological fields, including the theorem that the real and complex fields, and the quaternions, are the only locally compact, connected topological fields which satisfy the second axiom of countability. This is followed by three short chapters on Lie groups, compact groups whose dimensionality is finite, and on locally isomorphic groups respectively. The second of these contains von Neumann's solution, for compact groups, of the famous problem, which was proposed by Hilbert, to prove that any 'locally Euclidean' topological group is a Lie group.

The book concludes with a fairly complete account of the foundations of the Lie theory. This does not include the deep algebraic analysis of an infinitesimal group, or Lie algebra as it is now called, which was originated by Killing and carried out by Cartan. But it goes beyond the elements of the subject in giving, among other things, the third fundamental theorem of Lie in its complete form. The proof given depends on E. E. Levi's theorem that any infinitesimal group consists of its maximum invariant solvable sub-group, together with a semi-simple sub-group.

It will be seen from this brief description how the two books complement each other. Weyl presents a very thorough and complete account of certain groups in an algebraic setting. Pontrjagin is interested in general classes of groups and his background is primarily topological. The characteristic theorems in Pontrjagin's book are of the kind whose discovery demands imaginative brilliance, and when discovered can be presented in such a way that they are easy to follow. Of course, this implies a high tribute to the exposition. Indeed, the lucidity with which this book is written amounts in itself to genius, and the translator also deserves high praise. To return to the theorems, they are easy to follow just because of their generality. By contrast, the main theorems in Weyl's book are more special and, at the same time, more explicit. They do not merely assert existence, but actually calculate whatever is in question (a class of invariants, characters, or what not), and are intrinsically more difficult than the type of theorem in which simplicity accompanies great generality. As Weyl says in his preface : ". . . I am convinced that the special problems, in all their complexity, constitute the stock and core of mathematics ; and to master their difficulties requires on the whole the harder labor."

J. H. C. WHITEHEAD.

SCIENTIFIC ADVANCEMENT

Science Front, 1939

By Dr. F. Sherwood Taylor. Pp. 301 + 8 plates. (London, New York, Toronto and Melbourne : Cassell and Co., Ltd., 1939.) 7*s*. 6*d*. net.

THE flood of literature which has recently been pouring into the scientific ocean with each passing day renders it more and more difficult for scientific workers to keep abreast of developments in science other than those in which they are particularly engaged. Usually, too, lack of time and facilities for visiting libraries make it especially inconvenient for non-specialist science advocates like members of the teaching profession to consult, even occasionally, current periodicals. Frequently, their only contact with progress in science is obtained through 'popular' works or standard text-books, and inevitably their teaching becomes antedated, and now that scientific research has acquired a momentum which is little short of bewildering, any means whereby current developments may be more quickly transmitted to other scientific workers, teachers, etc. (and hence to the community at large), should be carefully investigated. For this reason Dr. Sherwood Taylor's book is worthy of consideration. The author has selected a dozen topics which, to him, represent the most significant advances made in science in the years up to and including 1939. He has, of course, been unable to include references to the bulk of the original work of 1939, since much of it remains obscure, tentative and unconfirmed. The choice of subjects will not accord with all points of view as to what constitutes the more important developments in science—workers in the applied sciences would undoubtedly feel that they have been rather shabbily treated—but at least the author has revealed a sense of perspicacity.

In the chapter on plant growth there is a historical sketch of the discovery of the auxins and heterauxins and their use in commercial plant-growing processes. Brief reference is also made to recent developments in hydroponics. "Progress in Chemotherapy" is concerned with a description of the methods by which the sulphanilamide drugs, particularly Dagenan (*M. and B.* 693), were elaborated. The far-reaching importance of these drugs in treating bacterial infections, such as septicæmia, pneumonia, meningitis and gonorrhea is graphically presented. In this chapter the author occasionally departs from factual statements and introduces opinions which are highly controversial. It is extremely doubtful, for example, whether Dr. Taylor is justified in speaking for all members of enlightened communities when he writes ". . . there is no community which does not despise the (sexually) impotent with a contempt which the victim himself shares". It is to be hoped that there has been some change of outlook in the 270 years that have elapsed since Mr. Wycherley made a butt of a sexually impotent man in his play, "The Country Wife". A further matter for regret is that some grave moral and social issues are dismissed in a flippant manner.

In other chapters are discussed the steroid compounds and their physiological effects upon human beings, as well as recent investigations in protein chemistry and physics, including an account of the action of intracellular proteinases. "The War Against Cancer" consists mainly of a description of Kögl's method for investigating stereoisomeric proteins inside the cell. The insulin shock treatment for schizophrenia is adequately described, while in a further chapter is an account of the Bergius, Fischer-Tropsch and other processes for making oil from coal. The chapter on television is involved and confusing, and would offer considerable difficulty to non-specialists in this field. Among other topics discussed are the quartz clock, helium II, present-day atomic hypotheses, the aurora, and finally, an account is given of modern ideas in astronomical science, this being partly devoted to R. A. Lyttelton's binary star hypothesis of planet origin and partly to interpretations about the composition and distribution of bodies in space.

By his industry in collecting material, and his assiduousness in collating it, Dr. Sherwood Taylor has made a substantial contribution to extending the range of science. On its merits his book deserves a wide circle of readers.

T. H. HAWKINS.

MENTAL TESTS

The Measurement of Abilities

By Dr. Philip E. Vernon. Pp. xii + 308. (London: University of London Press, Ltd., 1940.) 10*s*. 6*d*. net.

IN the past five years or so, the work of the International Institute Examinations Enquiry in Great Britain and elsewhere has, to some extent, awakened the public to the need for some radical revision of the examination system. Those who are alive to this social need will welcome Dr. Vernon's book, for it provides for teachers, school medical officers and students of education generally an up-to-date survey of simple methods which can readily be applied to this end.

Under present evacuation conditions, the necessity for just and accurate methods of assessing the abilities and attainments of school-children is particularly urgent. Large numbers of children will have missed many months of their normal education or will have had their normal course of development hindered or diverted. The discrepancies between ability and achievement will probably become more irregularly distributed in the school population. The book under review gives the teacher, headmaster and school examining bodies a means of overcoming these difficulties.

About half of Dr. Vernon's book is devoted to elementary statistical techniques applicable in educational work. The author's aim is wholly practical, so considerations appropriate to statistical theory are omitted. A wealth of illustration is provided of almost every type of problem in evaluating ability or achievement that might arise in school or clinic. The remainder of the book is mainly a critical account of mental tests and examinations, especially of the new type. The sections on construction and improvements of new-type examinations are particularly useful.

The author admits that contemporary psychological and educational research, unfortunately, makes far too much use of correlational techniques, while neglecting such valuable methods as the analysis of variance. In spite of this, we find about fifty pages devoted to the former and a brief single page, conveying little, to the latter.

The statement (p. 161) that most ways of factorizing tests "will lead to quite illogical results" must be questioned. If different results are obtained from different methods of factorial analysis, this is because these methods have different objectives and consequently vary in procedure as, for example, in estimating the diagonal cells in a correlation table. The final results of different methods may not be comparable, but they can scarcely be called "illogical".

J. I. COHEN.

KITCHEN WASTE FOR FEEDING FARM STOCK

By JOHN BEHARRELL,
BRITISH FEEDING-MEALS AND MILK PRODUCTS CO., LTD.

NEEDS and risks of war have enforced a drastic reduction in Britain's imports of food for livestock, and because of this the Minister of Agriculture recently warned those farmers who have been mainly dependent on supplies of grain and meal that they must prepare to cut down the numbers of their pigs and poultry to one third by the autumn.

There were on farm holdings in Great Britain in June 1939, 3,750,000 pigs and 63,000,000 poultry—including turkeys, ducks and geese; and a more recent census, taken last spring, showed, according to an official statement, that these numbers had undergone scarcely any diminution. Their management and care represent a considerable industry, and a capital expenditure of far more than £10,000,000 for housing and equipment. Large-scale reductions of pig and poultry stocks would therefore cause considerable hardship and, at the same time, appreciably lessen the available supplies of eggs and bacon.

Search for possible substitutes for imported feeding stuffs has directed attention to edible kitchen scraps, which hitherto have been wasted by the local authorities. Estimates of the quantity of edible kitchen waste produced in Great Britain vary. Mr. Price, an official of the borough of East Ham, said recently that food wastage averages 1 lb. per family daily. On this basis, and representing a family as 4·5 persons, the yearly waste of edible material in Great Britain would exceed 1,500,000 tons. Another authority has placed the national food waste at the much smaller average of 1 ton per 4,000 persons weekly, or rather more than 600,000 tons a year for the whole population. If this conservative basis be accepted, London alone is producing annually more than 100,000 tons of edible waste.

Obviously the best way of utilizing domestic food scraps is to keep poultry or pigs, and the new Order in Council setting aside tenancy and other restrictions on 'back garden farming' will no doubt help in this direction. An active campaign is in progress to stimulate the formation of cottagers' and allotment holders' pig clubs, which will make it their business to collect the food waste. As an inducement to them, the Ministry of Food has promised to earmark a proportion of available feeding meals to supplement the scrap collection.

A few farmers utilize swill from neighbouring towns, but are under compulsion to boil it. Neglect to boil thoroughly or even at all is declared to have been responsible for numerous recent outbreaks of foot-and-mouth disease and swine fever.

There are urban councils and boroughs enterprising enough to sort out and sterilize edible waste and either sell it to farmers or use it in their own piggeries. Watford, between January 14 and June 8 last, saved 210 tons, and besides selling to nearby farmers, has been feeding as many as 260 pigs at a time. Employees of Tottenham Cleansing Department have been encouraged to keep their own pigs, and now a hundred animals are being fed mainly on house scraps.

But after these and similar praiseworthy efforts have been taken into account, and after full allowance is made for a big prospective increase of poultry and pigs in back gardens, there will still remain an enormous residue of waste.

A new Order by the Ministry of Supply compels the larger local authorities to rescue metal and paper from domestic refuse, and also requires householders to do their part in the salvage. Provisions of the Order may soon be extended to food waste. But while non-perishable substances can be saved and transported at convenient times to conversion factories, food must be handled promptly if decay is to be arrested.

Fortunately, a number of well-equipped factories exist in various parts of Great Britain for the utilization of waste from the fish markets; and, until a few months before the War, were producing more than 70,000 tons a year of white-fish meal. On the declaration of War, more than one half of the country's fishing fleet was occupied on patrol work and other defence duties. The ports of Hull and Grimsby were almost closed and the various white-fish meal factories from Aberdeen in the north to London in the south were laid idle because of the lack of raw material. All these factories can convert any perishable food material into a dry, sterile meal, and indeed they have the equipment to handle a very large proportion of all the country's food waste.

The London factory with which I am associated has been converting market and domestic waste into a feeding meal for the past ten months, and is capable of dealing with 50,000 tons annually. The factory has been placed at the disposal of the Ministry for the duration of the War without profit. Already a number of London municipalities are collecting the food scraps, which consist of vegetable leaves, potato peelings and other residues, portions of bread and cake, particles of meat and fat, and are delivering them to the factory daily. The City of Westminster has instructed its street sweepers to make a systematic collection of kitchen waste. Tottenham, one of the pioneer boroughs in the salvage of domestic waste, is collecting about 25 tons of food scraps weekly. East Ham started experimentally in April; during the week ending June 22, thirty-three of the Council's sweepers brought in 13 tons of edible waste from 15,000 houses, and it is hoped to increase this quantity very considerably.

In these and other London areas the scheme has started with distribution by the Women's Voluntary Services of literature which explains the urgent need of war-time economy, and asks housewives to place their food scraps in a separate container, such as a cardboard box or carrier bag, which can be emptied by the sweeper as often as he calls. They are also asked to exclude tea leaves, orange and similar skins and rhubarb leaves.

At the present moment the London factory has guaranteed a minimum payment of 25*s.* per ton delivered to the works, based upon the market price to the farmer; but all public authorities have been assured that if after three months an audit by the Ministry of Supply or other authority shows a higher price to have been justified, the difference will be placed to their credit, and the local authority, and indirectly the ratepayers who have provided the material, will receive the benefit.

In heavily rated boroughs the new source of revenue from reclaimed waste is welcomed. East Ham, last May, received more than £1,000 from salvage, and Tottenham's gross income from this source is at the rate of approximately £15,000 a year.

As soon as the food waste reaches the factory, it is taken by conveyors to drying cylinders in which it is sterilized at 250° F., and dried until it is reduced to one fourth of its original bulk; after drying, the material is ground to a fine meal. Analysis of a sample of this meal by Dr. Bernard Dyer and Partners Ltd., shows the following:

Moisture	7·25
Oil or fat	8·00
Crude albuminoids (protein)	20·95
Digestible carbohydrates	41·17
Indigestible fibre	7·20
Mineral matter	15·43
	100·00

The production starch equivalent is calculated at 63, the protein equivalent at 15·8, and the linseed cake equivalent at 85, entitling dried town-waste to rank among concentrated foods. The mineral content is noteworthy because it includes 3·4 per cent of lime and 1·65 per cent of phosphoric acid. These are in the satisfactory ratio of 3·4 of calcium to 1 of phosphorus, and would make unnecessary the addition of a mineral supplement to any ration of which the meal forms a part. One feature revealed by the analysis is the presence of 30 parts of carotene per million—about the same proportion as is found in meadow hay. As the precursor of the fat-soluble vitamin A, carotene can play an important part in the nutrition of animals or birds which do not receive cod liver oil or a liberal allowance of green food.

Actual farm tests have shown that any mixture containing the town-waste meal is eagerly eaten by pigs and poultry, and that the response in growth or egg production is all the more satisfactory because in recent months they have not received as large a proportion of protein in their ration as they need. Digestible protein and its equivalent are utilized by the living body to repair waste, build up flesh and perform other vital functions. They cannot be stored, and as any excess of requirement is eliminated a fresh supply must be constantly maintained. A ration is wasteful and unprofitable if it is deficient in protein or in those minerals which are closely linked with them in the processes of nutrition.

Imports of oil cakes and similar concentrated foodstuffs rich in protein have been among those greatly curtailed, and supplies that are available must be reserved mainly for the feeding of dairy cattle. Substances consisting principally of protein, such as white-fish meal, dried milk and dried blood, are also restricted, and it is accepted as sound policy by the Government that it will be fairest to the farming community as a whole if they are incorporated in compound meals and so shared out impartially. When combined with town waste, they make a meal so highly concentrated that it can be used in the proportion of 1 part to 8 of cereals, and will go far towards meeting the normal requirements of farm stock.

Accepting the estimate quoted above of an annual domestic wastage of at least 500,000 tons of food in Great Britain, there must be material available for the production of a minimum of 100,000 tons of a dry, sterile and wholesome foodstuff which agriculture urgently needs. At about £12 5*s.* per ton to the farmer, it would be bought as quickly as the factories could maintain production, and would then be converted by the kindly processes of Nature into most useful food for the nation.

Housewives have shown themselves eager to help as soon as the need has been explained to them, and wherever collection facilities have been organized. Only systematic effort on the part of public authorities is now needed to make a very great success of the campaign.

GEOLOGY AND EARLY MAN: II*

By T. T. Paterson,

University Museum of Archæology and Ethnology, Cambridge

A Classification of Lower Palæolithic Cultures

The Lower Palæolithic nomenclature is rapidly approaching a state of complete chaos. Industries are found in greater frequency and their discoverers with enthusiasm set up not only new industrial names but also cultural. Correlation and comparison is becoming more and more difficult. Convergent technical similarities are wildly seized upon as indication of cultural spreads. A flake with plain, high-angled striking platform denotes the presence of the Clactonian culture even though found thousands of miles away from the home of that culture (*sensu stricto*). It seems the time has come to attempt to put order into this muddle of names, and it has been found that the application of a binomial system is of great assistance. The following is concerned only with cultures appearing in the Pleistocene up to and including phase u_2 and not with the 'Middle Palaeolithic' of u_3 or the 'Upper Palaeolithic' of the end of the Pleistocene.

Two great families are recognized: the *Acheul* and the *Clacton*. The Acheul elements of culture comprise the *biface*, manufactured from a given mass of material by striking off flakes from upper and lower surfaces in such a manner that the edges separating these surfaces are defined working edges, a form being obtained which can be included under the group name biface; flakes produced during the manufacture of the biface; and controlled secondary working (which does not appear in the very early Acheulian industries). The Clacton elements of culture comprise a series of ten types of cores, with the corresponding flakes removed from them: the irregular mass, the asymmetrical, the simple pebble proto-biconical, the multiple pebble proto-biconical, the biconical, the asymmetrical biconical, the proto-tortoise, the convergent tortoise, the longitudinal tortoise and the steep core. There is also a series of artefacts made from pebbles, flat based—end, side, and boat-shaped; rounded—with pointed or convex edges; nucleates (commonly called 'choppers').

The Acheul family shows no subdivision into what might be called genera, but it is otherwise with the Clacton family.

Family	'Genus' (Culture)	'Species'
Clacton	Breckland	
	Levallois	
	Moustier	
	Soan	Kafuan-Oldowan pre Stellenbosch and Stellenbosch I Anyathian, etc.
	Choukoutien	

Combinations of the Clacton elements constitute the various forms of culture or genera. In Europe the Breckland (hitherto known as the Clactonian *sensu stricto*) is the precursor of Levallois and carries the same generalized core elements as the Soan, which varies only in the dominant presence of pebble tools. The Levallois is a culture which early (end of phase m_1) separates off from the Breckland. The Moustier does the same at a somewhat previous time. The Soan includes the Kafuan-Oldowan complex and the various pebble 'cultures' found in East Africa, the pre- and early Stellenbosch, and the Anyathian from Burma, besides the industries discovered by Collins in Malaya, and by Koenigswald in Java. The Choukoutien is very closely allied to the Soan, especially in the light of the bigger pebble elements it carries. The material, as in the Anyathian, plays a most important part.

Where cultures come into contact, which was a very common occurrence especially after periods of climatic severity—cold in the north and aridity in the south—hybridization took place. The resultant mixed culture is therefore named according to the group cultural elements involved. The dominant group is given the 'generic', substantival name, and the secondary the 'specific', adjectival. A prefix is added to indicate time relationships, and a suffix where necessary to show local variation. An actual case is the Upper Brecklandian Acheul (Hoxne), which is that variety of industry occurring during phase u_2 at Hoxne in which the dominant element is Acheul and the secondary Breckland. Or in East Africa, the industry of the M-Horizon would be called Middle Acheulian Soan (Oldowan), so signifying the dominant Soan (Oldowan) element and the age as phase m_2.

The accompanying three-dimensional diagram (Fig. 1) represents in the simplest fashion the culture development throughout the Pleistocene, all but the last phase u_3. In the Lower Pleistocene

*Continued from page 15.

there occurred the first great subdivision of cultures, probably from a very generalized ancestral pebble tool form. The evolution to the Acheul form is partly illustrated in *analogous* fashion in Stellenbosch I (which is, of course, much later and Soan). It should be stated here that according to the definition of Acheul culture elements given above, the Abbevillian can have no separate cultural significance, but represents only an early stage in the development of the Acheul culture. Lower Acheul, which occupies phase m_1, is here understood to include late Abbevillian. Early Abbevillian would then become the pre-Acheul of phase l_2 of the Lower Pleistocene. Corresponding pre-Clacton and pre-Soan occur in l_1. Lower Breckland and Lower Soan come in phase m_1 like

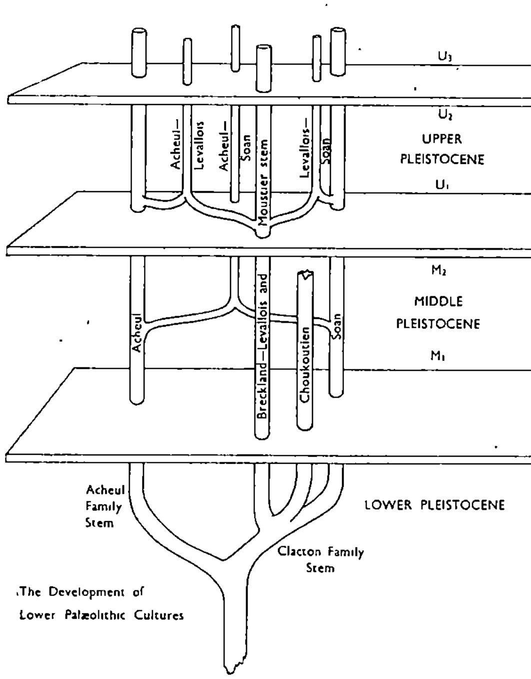


Fig. 1.

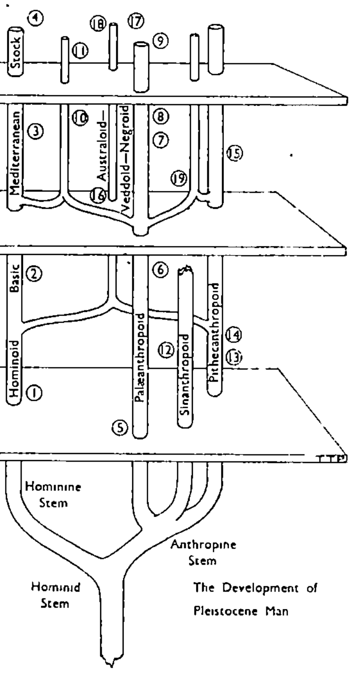


Fig. 2.

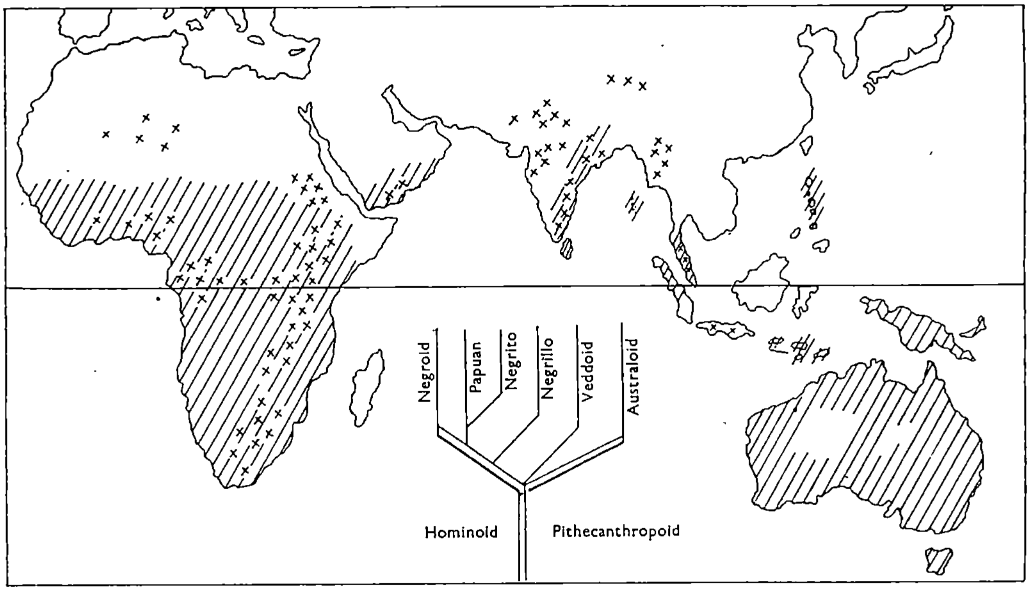


Fig. 3.

SHADING REPRESENTS THE DISTRIBUTION OF AUSTRALOID–VEDDOID–NEGROID STOCK ; CROSSES, THE SOAN CULTURE.

the Lower Acheul. The Middle Acheul, Breckland and Soan occupy m_2, Upper of all three in u_1 and u_2 and Final in u_3*. Lower, Middle, Upper and Final Levallois, and Moustier, occur in phases m_2, u_1, u_2 and u_3 respectively.

In the Middle Pleistocene in tropical latitudes the Soan and Acheul came together and we find in South Africa Stellenbosch II, in East Africa the Sangoan and the Middle Acheulian Soan (Oldowan), and in Peninsular India, Middle Soan Acheul and Middle Acheulian Soan. This hybrid culture form may develop on its own lines ; for example, as the Tumbian in East Africa, and a Tumbian-like culture all over India in the late Upper Pleistocene. The climatic extremes of the dry phase of m_2 in the tropics and the third glacial in the north brought all three main cultural groups together and much contact took place. In East Anglia, for example, there are Upper Brecklandian Acheul (Hoxne) and (Elveden), Upper Acheulian Levallois (Southacre)†, Upper Soan Levallois and Upper Levalloisian Soan in North India. Such hybrid forms developed on into phase u_3, when the great climatic extreme during the fourth glacial period not only wiped out Pleistocene faunas but caused again tremendous upheaval amongst mankind—the 'Middle Palaeolithic', essentially a stage of flux, came into being. Sometimes Levallois, sometimes Moustier, Acheul or Soan dominated, mixing and passing, coming and going—the pulsating birth of the 'Upper Palaeolithic' which emerged towards the end of the Pleistocene. In Fig. 1 no attempt is made to indicate the Middle Palæolithic flux, which would obscure the main form of the thesis the figure is intended to represent. Finally, it may be stated that within the Pleistocene, up to and including phase u_2, all industries can be adequately named by the use of one, or combinations of two or more, of six terms, Acheul, Breckland, Levallois, Moustier, Soan, Choukoutien, and with the aid of suffixes and prefixes, any special local characteristics (varietal forms) and the ages respectively can be represented.

THE DEVELOPMENT OF PLEISTOCENE MAN

It is already well established that Palæanthropoid man is associated with 'Levallois' culture and '*Homo sapiens*', as distinct from '*Palaeanthropus*', with the Acheul. At the symposium on the Middle Palæolithic during the British Association meeting at Cambridge in 1938, I further demonstrated the association of the Breckland with Ehringsdorf type, Levallois with Palestine type, and Moustier with the La Chapelle type. These associations are not given in the accompanying diagram (Fig. 2), since they would complicate the point at issue.

The first proposition submitted is that just as the cultural development shows mixture of cultural forms, so there have been produced hybrid physical forms owing to the mixture of stock following upon culture contact. Cultures do not remain consistently pure, nor do the racial stocks associated with them. Therefore in any attempt at classification of human Pleistocene fossils, regard must be paid to the factor of mixture, and even though a skull should show dominant characteristics of one racial form, nevertheless the presence of other racial characteristics must be indicated. It will be shown that racial hybridism was widely developed in the Upper Pleistocene, probably because of the same climatic catastrophe which altered the fauna, therefore the classification cannot follow the normal zoological method but the pedigree system applied to cross-bred domesticated animals. After all, man, especially in primitive societies, is essentially a domesticated animal subject to similar selective processes.

In the three-dimensional diagram (Fig. 2) two main lines represent the Palæanthropoid stem—associated with Breckland, Levallois-Moustierian—and a Hominoid basic Mediterranean stock—associated with Acheul. In the latter stem is placed Piltdown man (1) in very early Middle Pleistocene times. This interpretation of the age of the gravels of the Piltdown region, following Clement Reid, is based on their similarity to a very wide spread of gravels of m_1 age all along the southern coast of England. Swanscombe man (2) appears in phase m_2, in gravels heralding the third glacial stage. Here too, I suggest, would come the Kanjera skull. The artefacts associated with it are Middle Acheul on the system here adopted (Section C). From Upper Pleistocene loams of phase u_2 comes the Bury St. Edmunds fragment (3) and probably Galley Hill. At the end of the Pleistocene the man of Combe Capelle (4) represents this stock. In the Palæanthropoid stem there is *heidelbergensis* (5), probably intraglacial in age at the beginning of m_1. The age of the Steinheim skull (6) is doubtful, but it is probably similar to that of Swanscombe. Tabun and *ehringsdorfiensis* (7) and *neanderthalensis* (8) come from the Upper Pleistocene with *krapinensis* (9) at the end of the Pleistocene.

The contact between Acheul and Breckland—Levallois-Moustierian cultures first took place in phase u_1. In the Upper Pleistocene in a hybrid culture is found Skhūl man (10), showing not only Palæanthropoid characteristics but also others approaching those of the basic Mediterranean stock. At the end of the Pleistocene (11) come the

---

* A summary of the Acheul and Breckland subdivisions has already been given in NATURE, 143, 822 (1939).

† Discovered by Mr. J. S. Sainty.

La Chapelle group of types where the Neanderthaloid characteristics are still prominent.

It has been seen that there is a third great cultural stem, the Soan. So far the associated skeletal remains are Pithecanthropoid. Nevertheless the agreement of the distribution of the Soan culture with that of the Australoid-Veddoid-Negroid stock (Fig. 3) is suggestive. This brings forward the second proposition, that these peoples are survivors of those who produced the Soan industries. Towards the periphery of the distribution there is the series "*Homo*" *modjokertensis* (13) and *Pithecanthropus erectus* (14) in the Middle Pleistocene, *Homo soloensis* (15) in the Upper Pleistocene. Closely related is Pekin man (12) also of the Middle Pleistocene. In the latter period it has been noted that the Soan and Acheul cultures were in contact. In South Africa where this contact is extremely prominent has been found *rhodesiensis* (16), which is tentatively placed in phase u_1. The resemblances of this type to *soloensis* are quite well marked. *Africanthropus* (19) is associated with a contact Soan Levallois in the Upper Pleistocene. By this period the Negroid characteristics are already beginning to separate out; whereas, in the peripheral areas, a contact form has probably been evolving along its own lines, Wadjak (17), towards the modern Australoid. The Negroid characteristics of Grimaldi man (18) are well known. It is difficult to make any real constructive suggestion in relation to this 'outlier' except to point out that the Soan culture has reached well north in the Sahara, and the Languedocian of southern France may be its most northerly occurrence. The point must remain in question, but should the Soan have reached to Europe, then Grimaldi man must be the survivor of a contact between Hominoid and Pithecanthropoid types with probably late Palæanthropoid.

The third proposition is that the Australoid-Veddoid-Negroid stock differentiated in the following manner (see also diagram inset in Fig. 3). In Middle Pleistocene times somewhere to the west of Java, the Soan culture having already been widely distributed, a cross between a Hominoid and a Pithecanthropoid gave rise to the basal stock. On one side where the Hominoid element was stronger the Negroid developed, receiving very probably in the Upper Pleistocene some Palæanthropoid characteristics (vide *Africanthropus*). In the Australoid branch there was less Hominoid element. Early from the Negroid branch sprang the Veddoid, and later the Papuan racial type. The Australoid characteristics among some Negroid groups are due not to direct connexion with the Australoid race but are derived from a common ancestor, almost certainly Pithecanthropoid—as witness *wadjakensis*.

Thus it can be seen that, on general lines, morphological development corresponds with geological sequence. It must be remembered that should certain skeletal forms not agree with the theoretical morphological sequence, the lack of material is significant and survivals of early forms may occur out of their natural time grouping. In the Middle Pleistocene there was already a subdivision into three main stocks which it is suggested should be called Hominoid, Palæanthropoid and Pithecanthropoid (Sinanthropoid being regarded as close to the last). Since the assumption is made that hybridization occurred, then an absolute zoological taxonomic system ought not to be applied, but it is proposed that the skeletal remains belonging to these three generalized Middle Pleistocene stocks be given the status of genera. By the Upper Pleistocene, when much crossing had taken place, the various racial forms of present mankind were beginning to be moulded out. Remains from this period could then be given specific status. All later forms would be varieties of *Homo sapiens*. The suggested classification is set out below*.

LATEST AND POST-PLEISTOCENE. *Homo sapiens*, VARIETIES.

Homo species Upper Pleistocene	Homo *edmundi.* (Bury St. Edmunds) *londiniensis.* (Galley Hill), etc.	Homo *krapinensis.* *palestinensis.* *ehringsdorfiensis.* *neanderthalensis*, etc.	Homo *wadjakensis.* *soloensis.* *rhodesiensis.* *njarasensis.*
	(To be set up on a pedigree system.)		
Hominid genera Middle Pleistocene	Homo *H. marstoni.* (Swanscombe) *H. dawsoni.* (Piltdown) *H. leakeyi.* (Kanjera)	Palæanthropus *P. steinheim* (?) *P. heidelbergensis.*	Pithecanthropus *P. modjokertensis.* *P. erectus.* *P. pekinensis.*
Hominid sub-families Lower Pleistocene	Homininæ	Anthropinæ.	

It seems that of the three genera the Hominoid was predominant, the other two recessive, since it is the Hominoid which has alone survived in essence. The spread of the Hominoid stock which established its world-wide supremacy took place in the Upper Pleistocene and is associated with the distribution of the 'neanthropic culture'. Nevertheless, there seems to be no doubt that already before that the modern distribution was shaping itself. Weidenreich believes, for example, that he can see in *P. pekinensis* relationships to some present-day Mongoloids.

I would be grateful for criticism of these propositions.

---

* Mr. J. C. Trevor has been most helpful in discussing this matter.

THE SURVIVING CROSSOPTERYGIAN FISH, LATIMERIA

BY SIR ARTHUR SMITH WOODWARD, F.R.S.

IN NATURE of May 6, 1939, p. 455, Prof. J. L. B. Smith, of Rhodes University College, Grahamstown, announced the discovery in South African seas of a living Crossopterygian or paddle-finned fish. He recognized that it belonged to the group of Coelacanths, which was known only by fossils and was supposed to have been extinct since the end of the Cretaceous period. In the *Transactions of the Royal Society of South Africa,* he now describes in detail the remains of this fish*. Unfortunately, there are no more than dried remains; for when the specimen was sent to the East London Museum its scientific value was not appreciated, and it was entrusted to a taxidermist, who preserved little beyond the external parts and damaged some of these by piercing them with pins and nails. Prof. Smith laments his "relatively crude equipment" for dealing with the fish, but he is to be congratulated on his laborious effort and on the technical account of so much as he has been able to observe. His memoir is illustrated by an exhaustive series of photographs and a few diagrammatic text-figures. There is also an explanatory list of the numerals and letters used in all the illustrations, and this is arranged on a page which unfolds outwards so that it may be kept always in view.

The Coelacanths have changed very little since their first known appearance in Upper Devonian formations, and it is difficult to separate the new living fish from some of the old genera which are represented by fossils. For convenient reference, however, Prof. Smith has done well to give this fish a new generic name, Latimeria, which commemorates Miss Courtenay Latimer, the curator of the East London Museum. Very curiously, it retains the complete supplementary tail fin which characterizes the Jurassic and earlier genera, and thus differs from the latest or Cretaceous genera, Macropoma and Mawsonia, which have the tail extension reduced and lacking fin rays. Only the anterior dorsal fin, with its eight strong rays armed with upwardly pointing denticles, and the scales with their sharp denticles, are specially like those of Macropoma. The caudal fin seems to have a few more rays than any of the known extinct genera.

As in all Coelacanths, there are no scales on the head, and the sensory canals are conspicuous. The circumorbital plates, so commonly observed in Coelacanths, are absent. The two nostrils are well seen on each side of the snout, but Prof. Smith has been able to dissect this region and he thinks that they do not communicate direct with the olfactory capsules. These capsules are described as situated on either side of a large median chamber, which he names "ethmoidal nasal cavity"; and the cavity is said to be connected by tubes both with the two pairs of external nostrils and with a pair of openings on the front end of the snout. The remarkable arrangement needs further study in a better preserved specimen. The cranium, indeed, is so much damaged that Prof. Smith has been able to observe very little of it.

There is nothing unusual in the external bones of the head, but, as already suspected, it is now clear that the preoperculum is extended on the cheek as in the early Chondrosteans. There are also degenerate remnants of the suboperculum and interoperculum. The mouth is very interesting because, although there is no bony maxilla, this element is represented by "a thickened fold of skin" which bears the usual little tooth-plates or clusters of conical teeth. Especially important and new is the identification of the hyomandibular bone, which is described as "very firmly bound to the inner face of the anterior margin of the opercular". It is ossified only in its middle portion, the long ends remaining cartilaginous. From the hyomandibular there extends downwards and forwards a relatively large symplectic bone, which articulates with a hollow facet on the articular bone of the lower jaw, well behind the quadrate articulation. As Prof. Smith remarks, the arrangement is suggestive of that in the existing Chondrosteans. He points out that the facet on the articular bone has already been shown in published drawings of the lower jaw of the Devonian coelacanth Diplocercides; and he might have added that a pit in the same position has been described in the lower jaw of the Cretaceous Macropoma and Mawsonia.

The spiracle is supposed to have been functionless, but this portion of the head is badly preserved. The gill arches were destroyed, but the copula seems to show that there were only four pairs. Five pairs have been seen in some of the extinct Coelacanths.

The internal parts of the dried body have been so completely removed that little remains even of the skeleton. One hæmal spine in the tail, however, is seen to consist chiefly of cartilage surrounded by a thin cylinder of bone, thus exhibiting the structure to which the name Coelacanth (hollow spine) refers, for the cartilage disappears and leaves a hollow space in the fossils.

---

* J. L. B. Smith, "A Living Coelacanthid Fish from South Africa", *Trans. Roy. Soc. S. Africa*, 28, Pt. 1, 1–106, pls. i–xliv, 1939 (received April 1940).

The only new character described in the fins is the extension backwards of the membrane of the anterior dorsal fin beyond its eight rays. The extension is low and rapidly tapers behind, without any skeletal stiffening. The scales appear normal, and Prof. Smith observes ring-markings which he thinks prove the age of the fish to be between twenty and twenty-five years.

The exceptionally oily nature of Latimeria, already mentioned in the preliminary notice, is interesting geologically, because it indicates one possible source of the oil in many stratified rocks. Like most of the extinct Coelacanths, there is no doubt that it is a sea fish, not a straggler from a river. As Prof. Smith remarks, however, the annulation of the scales shows that it cannot be a denizen of the ocean depths. It must be well within reach of the ordinary fishermen, and the interest now aroused should induce the trawlers off the east coast of South Africa to save any more specimens which they may find.

OBITUARIES

Sir James Baillie, O.B.E.

SIR JAMES BLACK BAILLIE, who died on June 9 at the age of sixty-seven, was vice-chancellor of the University of Leeds from 1924 until 1938. A Scotsman, he was educated at the Universities of Edinburgh, Cambridge, Halle, Strasbourg, and Paris. At Edinburgh he had a particularly distinguished record, gaining the Ferguson scholarship and Shaw fellowship in philosophy, both open to graduates of the four Scottish universities. After graduation he was an assistant at the University of St. Andrews. Later he was lecturer in philosophy at University College, Dundee. He was professor of moral philosophy at the University of Aberdeen during 1902–24. He was knighted in 1931.

The most significant period of Baillie's life was when he was vice-chancellor at Leeds. He was keenly interested in problems of administration, and at Leeds this interest was fully satisfied. The University of Leeds saw great developments under his leadership. In 1925 an appeal was made by the University for the sum of half a million pounds for the purpose of erecting more adequate buildings. This appeal had realized about £700,000 at the time of his retirement, and many fine buildings had been erected, notably the Brotherton Library. Five new chairs and many lectureships and scholarships were instituted during Baillie's period of office, and valuable benefactions received. But human life is not merely thought or intellect in a narrow sense, as he himself showed in his "Studies in Human Nature"; there are other highly important activities. So Baillie did not forget, for example, the athletic and social sides of university life. Playing fields were developed at a cost of more than £50,000 and a beginning was also made with a new Students' Union, which has recently been completed.

In his administrative work Baillie showed great tenacity of purpose. He had the mind of an arbitrator, and indeed, both during the War of 1914–18 and since, he served in the capacity of arbitrator on several important Government commissions. His attitude of mind and methods were perhaps sometimes rather cold and impersonal. He had weighed the pros and cons, he had come to a conclusion, he must give effect to the conclusion for the conclusion's sake. But there was a warm and sympathetic side to Baillie's nature. He was an excellent host to a wide circle of friends and he was a good conversationalist and a good listener.

Baillie's main philosophical interest was Hegelianism. In 1901 he published a commentary, "The Origin and Significance of Hegel's Logic". His "Outline of the Idealistic Construction of Experience", 1906, is avowedly based on Hegel's "Phänomenologie des Geistes". Perhaps Baillie's most important contribution to philosophy was his translation, with an introduction and notes, of the "Phänomenologie". It appeared in 1910 and in a second edition, with a much improved text, in 1931. Its first appearance was particularly notable, for here was a major work of Hegel's made available in English for the first time. In 1924 Baillie was a contributor to the first series of "Contemporary British Philosophy", a collection of personal statements by leading philosophers, edited by J. H. Muirhead. He was also a contributor to Hastings' "Encyclopædia of Religion and Ethics", the *Hibbert Journal*, *Mind*, and other periodicals. As a philosopher Baillie was an ingenious and acute dialectician. He was, too, a most stimulating lecturer, illuminating his theme from all sides of human nature. In many respects his outlook was not unlike that of his illustrious predecessor, Thomas Reid, expounder of common sense. W. M. DICKIE.

Prof. Giuseppe Sanarelli

PROF. GIUSEPPE SANARELLI, the eminent Italian hygienist, whose death occurred recently, was born on September 24, 1865, at Monte San Savino, Arexzo. He studied medicine at Siena, Pavia, under Golgi, Munich under Pettenkofer, and Paris under Pasteur, and qualified in 1889 at Siena, where he began his career by being assistant to the professor of general pathology. In 1894 he was appointed professor of hygiene and director of the Institute of Hygiene at Siena, and during the next few years held corresponding posts at Montevideo (1895–98), Bologna (1898–1915) and finally at Rome.

Sanarelli's most important work was connected with the pathogenesis of cholera, typhoid fever, and spirochætosis, immunity and ultra-viruses. His name has been attached to the organism which is the cause of myxoma in the rabbit (*Sanarellia cuniculi*), but the organism which he called *Bacillus icteroides* and claimed to be the cause of yellow fever was shown by Reed and Carroll to be merely a variety of the swine cholera bacillus. In addition to numerous articles in periodical literature, such as the *Centralblatt für Bakteriologie*, *Comptes rendus de l'Académie des Sciences*, *Annales de l'Institut Pasteur*, etc., he was the author of several books. He was also the editor of the *Rivista di Malariologia*, which was founded in 1922 under the name of *Bolletino Malariologico*. He was the recipient of many honours. He was made a senator of Italy in 1920, and was rector of the University of Rome in 1922–23. He was also an honorary member of many learned societies in Italy and other countries. J. D. ROLLESTON.

Mr. F. M. Davis

EDUCATED at Harrow and at Caius College, Cambridge, Mr. F. M. Davis joined the staff of the Fisheries Department of the Ministry of Agriculture and Fisheries as an assistant naturalist in 1911; at the time of his death at the age of fifty-one he was principal naturalist in charge of the Fisheries Laboratory, Lowestoft.

Davis served in the War of 1914–18 as a captain in the London Regiment, was wounded, and held prisoner for nearly two years. On his return he spent many months carrying out investigations on trawlers, and he also made a very thorough survey of the fishing gear and methods employed in the maritime fisheries of England and Wales, the results of which are embodied in his well-known paper on the subject, now in its third edition (*Fishery Investigations*, Series II, 15, No. 2; 1936). He took part in an exploratory voyage to Lousy and George Bligh Banks in 1920. His subsequent work included several years investigation of the bottom fauna of the North Sea by means of the Petersen grab, resulting in two papers of great ecological interest, demonstrating *inter alia* the existence of vast beds of shellfish (Spisula and Mactra) on the Dogger Bank, which were subject to great fluctuations from year to year.

Thereafter Davis devoted several years to the practical study of the relation between the mesh of the trawl and the size of fish caught, and his results were basic for the international convention on mesh and size-limits signed in 1937. In the last year or two he became greatly interested in the great cod fisheries in the far north, and made several trips on trawlers to the Bear Island and Spitsbergen grounds. His bent was essentially practical; he was happiest at sea, and the vast experience there gained made him an acknowledged expert on all practical fishery problems, especially those relating to fishing gear.

Davis was a first-class rifle shot and had many successes at the Bisley meeting, which he attended regularly. His modesty was excessive; only those who knew him well could appreciate the shrewdness of his judgment and the depth of his knowledge, which he was apt to hide under a casual manner. He was greatly loved by his colleagues and a wide circle of friends. E. S. RUSSELL.

Mr. Jonathan Hodgkinson

OXFORD mathematics have suffered three grievous losses in the past few weeks by the deaths of Prof. A. E. H. Love, Mr. Jonathan Hodgkinson and Dr. E. G. C. Poole.

Jonathan Hodgkinson went up to Jesus College from Carlisle Grammar School as mathematical scholar in 1904. He won the University Mathematical Exhibition in 1906, was the Senior Mathematical Scholar in 1910 and obtained two first classes in the school of mathematics. From 1913 until 1921 he was a prize fellow of Merton College, one of the few colleges which retains this traditional reward of learning. During the War of 1914–18 he served in the infantry and with the Tank Corps as a major.

After the War, Hodgkinson became fellow and tutor in mathematics at Jesus College, and was for a time University lecturer in mathematics. He was a great teacher. He got good material with which to work and he made the very best of it. He worked his men hard but they responded, and the record of University honours in mathematics by the Jesus College men of the past twenty years is an impressive one. Although Hodgkinson was primarily a teacher he found time to do original work on the pure mathematics of applied mathematics. He was an authority on hypergeometric functions and published many papers on this and other subjects. For some years he was one of the three editors of the *Quarterly Journal of Mathematics*, and worked well and ungrudgingly at that difficult task.

In his college Hodgkinson was particularly helpful in matters of finance, where his analytical mind and shrewd commonsense were of value to his colleagues. Like so many of the mathematical and scientific dons in Oxford, he was an efficient administrator, and for some years wisely guided his college in disciplinary matters. During the last eighteen months his health had failed him, and though there were periods when it seemed that he might recover, at least in part, his health, he died on June 21. He was fifty-four years of age.

WE regret to announce the following deaths:

Mr. G. S. Blake, formerly geological adviser to the Palestine Government.

Dr. Alvin S. Wheeler, emeritus professor of organic chemistry in the University of North Carolina, on May 12, aged seventy-three.

NEWS AND VIEWS

Medicinal Plant Cultivation

EVENTS associated with recent developments of the War come as a disagreeable reminder of our dependence upon countries abroad for practically all kinds of vegetable materia medica. When Germany and areas in mid-Europe under German influence, followed by Poland, ceased to be sources of supply, the deficiency of most of the vegetable drugs could still be made good by imports from other countries. Belgium, Holland, France and Italy were alternative reservoirs which could be drawn upon abundantly, while the produce of areas in the Mediterranean zone, rich in many varieties of the raw materials of medicines, reached British ports almost unfailingly. Some of these outlets are now shut completely, and the rest of them have ceased to be easy of access. It is true that lands farther afield—India, various British Dominions and Colonies, the Americas, Japan, China and the Netherlands Indies, for example—can send us their produce, but most of these countries are almost as dependent as ourselves upon importation from the same sources as those from which we have obtained our supplies. This is all the more curious, because it would be difficult to name a single vegetable drug which could not be produced economically in some part of Britain overseas or in the Americas.

The need of the moment is to establish as speedily as possible a system by which Great Britain may provide itself with all the medicinal plants which can possibly be cultivated on British soil. Good stocks of the more essential of the vegetable drugs are already in the country, and if plans for extensive cultivation are brought into operation without delay, there need be no shortage of many of the commonly prescribed vegetable drugs. The Pharmaceutical Society is anxious to do what it can to support a campaign to make Great Britain as self-sufficient as possible in this respect; further, Mr. T. E. Wallis, Hanbury medallist for 1940 of the Society, has volunteered to give advice to amateur gardeners who are prepared to undertake the work of cultivation. Admittedly there is a limit to the variety of plants which can be grown in British soil, but home production can be supplemented by the support of Britain overseas. In past times when medicinal herb cultivation by smallholders has been attempted, an obstacle to complete success has been the absence of drying and collecting centres, but the need for production is now so urgent that it is impossible to believe that means will not be found for the proper organization of a necessary industry, even if the State has to lend a hand.

Work of the Patent Office

THE fifty-seventh report of the Comptroller-General of Patents, Designs and Trade Marks, for the year 1939, indicates that the steady increase in the number of applications for patents and complete specifications characterizing the previous three years continued until the outbreak of war, afterwards decreasing by about one third in comparison with the same period of the previous year (Pp. 26. London: H.M. Stationery Office, 1940. 6*d*. net). In regard to patents, the total number of applications was 33,109, of provisional specifications 20,095, of complete specifications 20,610, and of patents sealed 17,605, as compared with 37,973, 22,696, 23,098, and 19,314 in 1938, respectively.

The trend of invention showed considerable activity in the production of motor fuels of high anti-knock value by alkylating isoparaffins with olefines in presence of a catalyst. The preparation of organo-metallic compounds for addition to motor fuels to increase their anti-knock value has also received attention, as well as the synthesis of the hormones of the adrenal cortex. Marked progress has been made in the synthesis of some of the more important vitamins the chemical structure of which has recently been elucidated. Attention is being directed to methods of extracting cellulose from plant materials hitherto not utilized, such as highly resinous woods and certain grasses, and also to the preparation of polyamide resins for use in the manufacture of artificial fibres. The contemplated extension of full automatic working to the setting up of long-distance telephone connexions has led to considerable activity, and numerous aspects of passive defence such as respirators, air-raid shelters, electric torches, masks and shades, blinds and shutters, etc., also figure prominently.

Applications for licences under separate patents under the Emergency Act have numbered 754, and for the variation of pre-War licences in respect of individual patents 109. Orders have been made granting 207 licences in respect of separate patents and amending 12 pre-War patent licences. In dealing with applications for licences under this Act, it has been taken that the main object of the licensing provisions is to enable and encourage the working in Great Britain of useful inventions which are covered by enemy-owned patents, and for that reason could not or would not be utilized here during the War. Steps have also been taken to prevent the risk of publication abroad of details of any invention of which disclosure might be contrary to the interests of the realm or of service to the enemy.

Re-grassing

ADVICE supplied by the Welsh Plant Breeding Station at Aberystwyth on grassland management is sure to be studied with interest as it is based on so much practical experience. In its War Food Production Advisory Bulletin No. 1, entitled "Re-grassing" (1*s*.), Sir George Stapledon stresses the importance of developing a far-seeing policy, which both aims at increasing current food production and at the same time has due regard to creating enhanced fertility of the land for the future. Grassland now being ploughed up for cereal growing should be brought under some fertility sustaining rotation, while grassland at present too poor to be worth ploughing up for cereals should be improved as such, so that it can be ready for the plough in two or three years time. Further, every effort must be made to improve the quantity and quality of existing grass to compensate for the acreage lost to the plough.

The means of achieving these aims, Sir George maintains, is the ley, those of three years and upward making for a sound system of alternate husbandry, and the bulletin is largely devoted to describing methods which will most rapidly convert poor permanent grassland into good leys. Three main methods of procedure are given, namely, the sowing of seeds mixtures, with or without a cereal covering crop, directly on the prepared surface of the upturned sod, and the sowing of rape and Italian rye grass as a preparation for a subsequent ley mixture. The all-prevailing notion that a ley can only be economically established under a cereal nurse crop at the end of a rotation is shown to be contrary to facts, for experience has proved that newly broken grass is an excellent starting point and that a cover crop is not essential. The value of sowing pioneer crops such as Italian rye and rape on land which is at present unproductive is also strongly stressed, as it provides back end and early spring keep and will help to make the land sward- or cereal-worthy at a later date. The bulletin supplies numerous details regarding manuring and seeds mixtures and gives examples of the experience of farmers from different parts of the country in support of the policy advocated.

Family Allowances

IN a pamphlet entitled "An Aylesbury Broadside" (price 3*d*.), the *Lancet* surveys the case for family allowances. The subject is dealt with mainly as a public health problem, for in 1938 there were at least 189,000 school-children in England and Wales suffering from malnutrition. Unfortunately, in most cases wages do not expand with the advent of children, and what sufficed for the family of one or two children becomes inadequate when there are three or more. Further, malnutrition in men is serious enough, but it is trivial in its effects on the race compared with ill-health in child-bearing women. Food requirements and the cost of adequate diets are discussed, and from the medical point of view the *Lancet* considers that there is an excellent case for paying a flat rate of 5*s*. for every child in the country. The principle of family allowances is actually admitted in the case of certain income-tax payers and in separation allowances for the families of soldiers, and a growing number of industrial firms have established family allowance schemes of their own. Various suggested schemes are outlined, namely, to place the whole onus on the employer, to let the State pay out of taxation, or a contributory scheme in which employers, workers and the State all take a share. A State scheme would probably cost £118,000,000. Certainly a case seems to be made out for the payment of family allowances of the order of 5*s*. for at least the third and subsequent children.

Economics of the State

A PAMPHLET, "The New Social Order: its Mechanism", by a group of scientific workers, which is edited by A. H. Mackmurdo, emphasizes the importance of the economic position and advocates the elaboration of an economic unit to organize distribution of resources upon an equitable scale (London: The C. W. Daniel Co. 6*d*.). In each State, the national economy would be based on a fixed price for the staple foodstuff, this fixing the price of all home-grown foods and, in turn, the price of all national goods and services, and each living wage would be measured upon this price-scale. The social mechanism to remove the paradox of potential plenty and actual poverty is regarded as involving three changes: a radical change in the mechanism of a commonwealth distribution; an instrument for measuring the distribution of the portions of this common wealth to be distributed to the members of the community as co-partners of it; and a regulative organ to control and guide the highly specialized organs of production, regulate the machinery of distribution and control all national imports and exports. The first change involves a new wage system and the disappearance of public or private ownership in the fruit of the common effort. The second involves the establishment of a new form of national money, and in the third, growth of the social service conception is essential, leading to the development of occupational organizations, which will regulate the economic affairs of the industry or occupation in the interest of the whole community.

The School of Salerno

IN a paper read before the Section of the History of Medicine of the Royal Society of Medicine on June 25, Dr. H. P. Bayon referred to his previous communication on this subject (NATURE, March 30, 1940, p. 507), and said that it was generally agreed that a broad stream of Hippocratic medicine could be traced from classical times to the present day. Hippocrates was mainly concerned with the observation of symptoms for prognostic purposes, while Galen seven centuries later made diagnosis subservient to treatment. During the following nine centuries the Hippocratic stream became a mere trickle, just recognizable in the writings of philosophers like Hrabanus. In the ninth century the practitioner of medicine, when not a monk, was a *medicus* who employed spells and charms and could scarcely read or write. In the East, on the other hand, physicians and surgeons were trained by learned teachers. At the time of the first Crusade the Masters of Salerno first arose, adopted the title of *Magister* like that of expounders of the law and taught by means of the excerpts and compilations of Moslem and Hebrew writers like Constantinus Africanus, who died about 1087.

The Salernitans established by example and precept that the practitioner of medicine should be a learned person, not only a skilled craftsman. They concentrated on the treatment of symptoms, made a timid attempt to learn anatomy, and, what is particularly remarkable for their time and locality, avoided magical formulæ or miraculous faith-cures. It may be surmised that they modelled themselves on the practice of Moslem and Hebrew physicians. Their literary activity stopped with the sack of Salerno in 1196; but the famous edict of Frederick II regulating the practice of medicine was issued in 1240 when a "College" had been formed. The *Regimen Salernitatum* in its original form was not particularly important medically; when it became popular, it was altered by others; the significant Salernitan writings were *Copho, Antidotarium, Trotula* and *Rolandina.* The essential achievement of the Salernitans was the advancement of medical practice on those professional lines which it had preserved to the present day.

Stone Age Cilicia

A REMARKABLE prospect of the future which will lie open to intensive archæological investigation in Cilicia was given by Mr. Miles C. Burkitt in a report recently presented (May 7) to the Royal Anthropological Institute on his examination of the stone industries of the lower levels found at Tell Halaf, near Mersin. This Tell, which is being explored by the Neilson Expedition under Prof. J. G. Garstang (see NATURE, 143, 464; 1939), has proved to be one of the most important sites in the Near East. Mr. Burkitt's examination of the lower levels by a terrace excavation beginning at the lower limit of the Tell Halaf culture, and extending downward nearly to river-level, has revealed a proto-chalcolithic culture with deposits of 3 metres depth, and below this an upper and lower neolithic of 9 metres together.

Each of these deposits has yielded a characteristic pottery, of which the chalcolithic is a painted ware, some reminiscent of Nineveh, while other sherds resemble painted pottery of Thessaly. In this level mud-brick was in use and there was a poor industry of obsidian and chert. In the Upper Neolithic level the pottery was fine but undecorated. Mud-brick was not in use, while obsidian implements were more numerous than in the higher level. The pottery of the Lower Neolithic consists of hole-mouthed vessels of softer, coarser ware, which are well burnished and frequently show an incised decoration. Similar wares at present have been found only at Ras Shamra in the lowest levels. The obsidian industry is striking and includes beautiful lance-heads and daggers, flaked by pressure. These industries antedate anything hitherto discovered in this part of the Near East. In Mr. Burkitt's opinion these discoveries auger well for the prospects of the discovery of late Paleolithic industries in the many rock shelters to be explored in the foothills of Taurus bordering Cilicia.

Wolf-Children

IN his presidential address on this subject delivered before the Folk-Lore Society on February 21 (*Folk-Lore*, 51, 9; 1940), Dr. J. H. Hutton deals with the cases recorded from classical antiquity down to the present time of children having been reared by animals, especially wolves. The earliest record of a wolf-child which he has discovered in northern Europe is that reported by William Dilich in 1341 as occurring in Hesse. Two Lithuanian cases of wolf-children were described by Connor in his "History of Poland", published in 1698, since when no cases have been described in Europe. Many recent cases, however, have been reported from India, mostly from the United Provinces, and also from Central India, as well as from Africa.

Wolves are not the only animals which have been said to have carried off and suckled children. In classical antiquity, Atalanta is stated to have been suckled by a bear and Cyrus by a bitch, while in recent times bear-children, jaguar- and leopard-children have been recorded in India, and lion-children and a baboon-child in Africa. It is a remarkable fact that no stories of the kind have been reported from the New World, where examples of wolf- and bear-children might have been expected from North America and jaguar- and puma-children from South America. Although it has been suggested that wolf-children are idiots who have wandered into the jungle and taken up their abode in the dens of wolves, this hypothesis is by no means universally applicable, notably in the case of the jaguar-child in the North Cachar Hills, India. Dr. Hutton comes to the conclusion that the evidence from India of wolf- and leopard-children and from Africa of a baboon-child seems to support the hypothesis that the belief is founded on observed facts.

Research at Port Erin

THE report for 1939 (No. 52) of the Marine Biological Station at Port Erin, Isle of Man, drawn up by the director, Prof. J. H. Orton, shows that the oyster investigations and other researches have been continued and that the director submitted to the Manx Government a memorandum on the prospect of the development of an oyster fishery in the neighbourhood of the Isle of Man. It is stated that during the past year pressure of work caused Dr. R. J. Daniel to resign his directorship. Arrangements are being made for the transfer of the direction of the Station from the Department of Oceanography to the Department of Zoology in the University of Liverpool.

The new plans for the development of the Station unfortunately have all been temporarily cancelled owing to the War. These include increase of staff, new tanks, more efficient pumps, electricity for light and power, a store hut on the quay for gear, and funds acquired to keep the motor-boat continuously in commission and available for all research workers. It is to be hoped that these additions are merely postponed and that a successful future will be assured for this laboratory which has produced so much good work.

Swiss Short-Wave Emissions

AN article by Paul Borsinger, chief of the Swiss short-wave service, is published in *Swiss Industry and Trade* of May. The Swiss short-wave service was inaugurated some years ago. It was organized before the existence of an exclusively Swiss transmission station. The League of Nation's transmitter, located at Prangin near Geneva, was rented for that purpose at certain free hours. In the first stage, the service was limited to one weekly broadcast for Swiss citizens in each continent separately. The programmes intended for the Swiss were of a homely popular character, but for foreigners an endeavour was made to convey a rounded-out conception of Switzerland's artistic achievements, of her general activities and of her age-old ideals. The talks were enhanced by samples of Swiss musical art, popular music with the more stately and the classical with the modern. Unfortunately, when the first station was practically finished it was burnt down.

The new Swiss station is now well on the way to completion. It is situated at Schwarzenburg, about twenty kilometres from Bern. The construction of a short-wave station is a heavy and costly undertaking for a small country of no more than four million inhabitants. The reconstruction of the station without loss of time and in spite of the enormous difficulties of a world crisis is a proof of the tenacity and capacity of Swiss engineers. Until quite recently, the short-wave transmissions have been in the experimental stage. But now rapid progress is being made. It is expected that a regular daily programme will be organized for all continents. The first step will include a one station service only, with two directed aerials for North America, one for South America, two for Africa and one for the Far East. The second step will bring two additional areas for Central America, Southern Asia and Australia, and a circular emitter which will ensure the listeners in bordering European lands of good reception, and in addition a second station will be connected with all these different types of emitters, allowing thus simultaneous transmissions of two programmes on different wavelengths and for different destinations. The station will for financial reasons have to find ways and means of recuperating a part of its investment. To this end, the second transmitter will be placed principally at the disposal of a radio-telephone service with overseas countries.

"Metallurgical Abstracts"

THE Minister of Labour in a recent speech said: "I want to shorten the war. I believe it can be shortened, but nothing but metal will do it". No more emphatic statement of the importance of the metallurgist in the present struggle could be desired. In connexion with all metallurgical work the accessibility of complete and authoritative abstracts of the research work published throughout the world is essential. For many years the "Metallurgical Abstracts" of the Institute of Metals have been widely recognized as fulfilling these requirements, and the latest volume fully upholds the reputation of its predecessors ("Metallurgical Abstracts" (General and Non-Ferrous). Edited by S. C. Guillan. Vol. 6 (New Series), 1939. Pp. xii+683. 1940. London: The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1. Subscription price, including two bound volumes of the *Journal of the Institute of Metals*, £4, post paid). In every metallurgical and most engineering establishments of the country where non-ferrous metals are produced, fabricated or used, this volume is essential.

The *Journal of Pathology and Bacteriology*

WITH the May issue, this journal completes its fiftieth volume. Founded in 1892 by the late Prof. Sims Woodhead, it has consistently maintained its position as an authoritative journal of British pathology, and much of the best work in pathological and bacteriological research of British investigators has appeared in its pages. Commendation must be expressed with regard to paper and type, and the excellent illustrations have always been a feature. The present number which, in spite of war-time restrictions, maintains the high standard of its predecessors, contains thirteen papers covering a wide range of subjects in human and animal pathology, bacteriology, chemotherapy and other topics, together with some shorter articles and book reviews.

University of Iceland

IT is stated by the Reykjavik correspondent of *The Times* that the University of Iceland recently celebrated the twenty-ninth anniversary of its foundation by inaugurating a new university building, erected with the proceeds of a lottery authorized by the State. The British Minister, Mr. Charles Howard Smith, was present, and messages of congratulation were received from the Universities of Cambridge, Dublin, Leeds, London, Oxford, and Abo (Finland), and Yale University. The new building is large enough to house all the faculties of the University, which has until now had to make use of temporary quarters in the Parliament Building.

Announcements

DR. RICHARD KRONER, the well-known German Jewish philosopher and formerly professor at Dresden, Kiel and Berlin, who left Germany two years ago, has been appointed professor of logic and metaphysics at McGill University, Montreal.

THE National Academy of Medicine of Mexico has recently celebrated the centenary of the birth of the Mexican hygienist Edoardo Licéaga (1839–1926), author of works on inoculation against rabies, protection of the ports and frontier cities of Mexico against cholera, and the geography and prevention of yellow fever and typhus.

ERRATUM.—In the leading article on salvage and utilization of waste in NATURE of June 29, p. 988, reference was made to the utilization of woollen rags in the manufacture of high-grade paper. For "woollen" should be read "cotton".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Site of Action of Œstrogens

WE have attempted to determine whether œstrogens act directly on the vagina or whether they have to be absorbed into the general circulation before they can produce their action by the following method. Female mice were operated under ether anæsthesia and the vagina was separated from the bladder and urethra. It was then cut into approximately equal upper and lower parts. The upper end of the lower part of the vagina was sewn up, thus making a small vaginal sac with a normal opening. The lower end of the upper part of the vagina was then drawn up to the region just above the symphysis pubis, and implanted into the anterior abdominal wall. This upper vaginal sac, with an opening into the suprapubic region, was thus entirely separate from the lower vaginal sac. Healing occurred rapidly and a few days after the operation a bilateral ovariectomy was performed. Some ten days later the animals were ready for experiments.

In control experiments, œstradiol in saline was injected subcutaneously and the response of the upper and lower vaginæ were measured quantitatively by the method previously described[1]. The extent of the œstrogenic response was greater in the lower than in the upper part of the vagina, a result in agreement with that obtained by Robson and Wiesner[2] from histological examination of the vagina of ovariectomized mice following the administration of œstrin.

Œstrogens were now injected into the lumen of the upper vagina in doses which are insufficient to produce any appreciable effect when administered by the subcutaneous route. The substances, in solution or suspension in saline, were administered by means of a micro-syringe, with which 0·001 c.c. was given at each injection.

It was surmised that if the œstrogen had to be absorbed from the vagina into the general circulation before any effect could be produced, the response, if any, would be more marked in the lower than in the upper vagina. On the other hand, if the œstrogen could act locally without absorption into the general circulation, it might well produce a marked effect in the upper vagina without affecting the lower vaginal sac.

Œstrogen	Total dose given (μ gm.)	Site of injection	Average scores of vaginal responses		No. of animals
			Upper vagina	Lower vagina	
Œstradiol	0·1	Subcutaneously	5·0	7·5	4
Œstradiol	0·25	,,	6·0	8·4	5
Œstradiol	0·005	Upper vagina	2·7	0	4
Œstradiol	0·01	,, ,,	6·6	0·9	15
Stilbœstrol	0·01	,, ,,	5·9	1·3	7
Stilbœstrol	0·2	,, ,,	11·4	0·4	9
Œstriol glucuronide	5·0	,, ,,	7·3	1·2	15

The results are shown in the accompanying table. It will be seen that all three œstrogens used, namely, œstradiol, stilbœstrol and œstriol glucuronide produced some degree of cornification when injected into the upper vaginal sac and that there was practically no effect in the lower vagina. The results obtained with stilbœstrol were especially striking, since the administration of 0·2 μgm. of this substance into the upper vagina produced very marked effects, four out of the nine animals showing complete cornification, while the lower vaginæ were practically completely unaffected. These results thus show that natural and synthetic œstrogens can act locally without absorption into the general circulation.

Emmens and Ludford[3] have recently shown that œstrogens produce no effect on the vaginal epithelium in tissue culture and have suggested, like Hechter, Lev and Soskin[4], that the effects of œstrogens may be dependent upon the production of hyperæmia. The present experiments are in no way in disagreement with such a hypothesis, since the local response to œstrogens occurred in the presence of an intact vaginal blood supply.

The local response to œstriol glucuronide is also of interest since it shows that either the vagina can respond to conjugated œstrogens or that the compound can be split locally in the vagina.

J. M. ROBSON.
J. ADLER.

Department of Pharmacology,
University of Edinburgh.

June 5.

[1] Robson, J. M., *Quart. J. Exp. Physiol.*, **28**, 195 (1938).

[2] Robson, J. M., and Wiesner, B. P., *Quart. J. Exp. Physiol.*, **21**, 217 (1931).

[3] Emmens, C. W., and Ludford, R. J., NATURE, **145**, 746 (1940).

[4] Hechter, O., Lev, M., and Soskin, S., *Endocrinology*, **26**, 73 (1940).

Gluten Protein

THE validity of Osborne's conclusions[1] that gluten is made up of the two proteins, glutenin and gliadin, has been rendered doubtful by more recent work, but no general agreement as to the true nature of the material has been reached. The work of Krejci and Svedberg[2,3] using the ultracentrifuge, and of Lamm and Polson[4] using diffusion suggested that more detailed studies using these methods would contribute greatly to solving this problem. Such studies have been in progress in Uppsala during the past winter. It has been considered essential to include as much as possible of the whole gluten protein in these studies, and as sodium salicylate has previously been shown to be the most generally satisfactory dispersing agent for gluten[5,6], this solvent has been used almost exclusively.

Two series of results are of primary importance. First, the dispersing power of sodium salicylate is directly proportional to its concentration up to 8 per cent. This had already been determined[7], but concentration calculations from the ultracentrifuge diagrams show that only part of the protein dispersed is in true molecular solution. The crude dispersions, even after the complete removal of starch, are opaque. This opaque material is rapidly sedimented out at a relatively low speed in the ultracentrifuge, as is some of the protein in the clarified dispersion. About 35 per cent of the gluten protein was dispersed in 2 per cent salicylate, but less than half of this (14 per cent) was in molecular solution. Dispersions of a soft wheat gluten in 2, 4, 6, 8, 10, 12 and 16 per cent sodium salicylate were ultracentrifuged at 65,000 r.p.m. (centrifugal force about 300,000 times gravity). The percentages of the gluten protein found to be in true solution were 14, 34, 48, 68, 72, 84, and 77 respectively. This relation is approximately linear up to 8 per cent, the point at which dispersion is virtually complete[7]. The sedimentation constant (s_{20}) of the molecularly dispersed protein was nearly constant at about 2·5. (Sedimentation constants are given in units of 10^{-13}, and diffusion constants in units of 10^{-7}.) Some of the protein that sedimented out of solution at low concentration of salicylate was molecularly dispersed in higher concentrations, and yielded the same s_{20} values as the more soluble fractions. This fact was verified by fractionating the protein into four fractions and subjecting each to ultracentrifuge studies. The s_{20} values obtained were the same for all fractions, but the percentage of the protein molecularly dispersed decreased with decreasing solubility of the fractions.

The second series of results was obtained by diffusion[4]. Gluten protein was clarified in a low-speed ultracentrifuge at 12,000 r.p.m. (centrifugal force about 10,000 times gravity) and fractionated to yield four fractions on the basis of solubility. The diffusion constant (D_{20}) of each fraction was determined and found to be 2·14, 3·13, 4·12 and 4·83 for the four fractions, starting with the most insoluble. The fractions were recombined and the diffusion constant of this material was 3·36, in good agreement with the weighted mean of the results for individual fractions, which was 3·32. The diffusion curves showed that each fraction was itself highly inhomogeneous, and the values of diffusion constants given are mean values. These results are substantiated by the use of the equilibrium centrifuge. The mean molecular weight of the most soluble fraction (23 per cent of the total gluten) was 44,000, this value being obtained by both the sedimentation-diffusion method, and the equilibrium method[8]. The weights of the other fractions were much higher and increased progressively with decreasing solubility.

Considering the two series of results together it is at once obvious that the shape of the molecules in the different fractions must be very different. The molecules are undoubtedly long and thin, and it seems certain that the dissymmetry increases as solubility decreases. It also seems certain that there are many lengths of molecules, and that the theory of two, and only two, distinct and different proteins, 'glutenin' and 'gliadin', in the gluten, must be rejected. The suggestions of Sandstedt and Blish[9] and of Blish[10] that there are three or only a few rather distinct components do not seem to fit the present results any better. (Studies on acetic acid dispersions also showed gluten to be inhomogeneous.) The hypothesis advanced in earlier papers[7,11] that the gluten protein is a protein system made up of components varying regularly and systematically in chemical and physical properties is strongly supported by the present work.

Full details of this research will be published in the *Canadian Journal of Research*. We wish to thank Prof. The Svedberg, Uppsala, for providing facilities for carrying out the studies. The expenses incurred at the Institute of Physical Chemistry, Uppsala, were defrayed by grants from the Rockefeller and Wallenberg Foundations. The salary of the senior author was paid by the National Research Council of Canada, and other expenses were supplied by the Searle Grain Co., Ltd., Winnipeg.

A. G. McCALLA.

Department of Field Crops,
University of Alberta,
Edmonton.

NILS GRALÉN.

Institute of Physical Chemistry,
The University,
Uppsala.
May 23.

[1] Osborne, I. B., Carnegie Inst. Wash. Pub., 84 (1907).
[2] Krejci, Laura and Svedberg, The, *J. Amer. Chem. Soc.*, **57**, 946 (1935).
[3] Krejci, Laura and Svedberg, The, *J. Amer. Chem. Soc.*, **57**, 1365 (1935).
[4] Lamm, O., and Polson, A. G., *Biochem. J.*, **30**, 528 (1936).
[5] Rose, R. C., and Cook, W. H., *Can. J. Research*, **12**, 63 (1935).
[6] Cook, W. H., and Rose, R. C., *Can. J. Research*, **12**, 248 (1935).
[7] McCalla, A. G., and Rose, R. C., *Can. J. Research*, **12**, 346 (1935).
[8] Svedberg, The, and Pedersen, K. O., "The Ultracentrifuge", Oxford (1940).
[9] Sandstedt, R. M., and Blish, M. J., *Cereal Chem.*, **10**, 359 (1933).
[10] Blish, M. J., *Cereal Chem.* (Supp.), **13**, 16 (1936).
[11] Spencer, E. Y., and McCalla, A. G., *Can. J. Research*, C, **16**, 483 (1938).

Production of Oxygen by Illuminated Chloroplasts

THE activity of isolated chloroplasts in light, measured by the oxygen evolved from ferric oxalate, has been shown to be relatively high. The ferric oxalate is reduced to ferrous oxalate and oxygen, which is equivalent to the iron reduced, and was measured by means of hæmoglobin. The maximum pressure of oxygen obtainable, however, was only 4 mm. mercury[1,2]. It has now been proved, by direct measurement of the oxidation of ferrous oxalate, that this low limit of oxygen pressure obtainable simply results from the re-oxidation of the ferrous oxalate produced by the illuminated chloroplasts. If the oxygen uptake due to the oxidation of the ferrous salt can be prevented, oxygen should accumulate to a higher pressure and be capable of direct measurement. It was found that ferricyanide rapidly oxidizes ferrous oxalate in the presence of excess of potassium oxalate.

Potassium ferricyanide does not itself produce oxygen with the chloroplasts in light. But when a mixture of potassium ferricyanide and ferric potassium oxalate is illuminated in the presence of chloroplasts, molecular oxygen is evolved at a pressure above the atmospheric. The gas evolved was proved to be oxygen by Krogh's method. Experiments were then carried out in Barcroft manometers at 20° C. and the rate of oxygen evolution determined. The results are shown in the table below, and were obtained as follows. The experimental fluid contained the chloroplast suspension in sucrose $M/5$, potassium oxalate $M/2$, potassium ferricyanide $M/10$, ferric oxalate $M/500$, and phosphate buffer pH 7·0 $M/15$. 5 c.c. were introduced into each cup of the manometer with 10 per cent caustic potash in the centre pot. The left cup was darkened while the other was illuminated from below with approx. 10,000 lux. The concentration of chloroplasts is expressed in terms of the dry weight of the whole leaf from which they were obtained.

Stellaria media.	Dry weight 43 mgm.
Q_{O_2} 7–15 min.	7·8
,, at 40 ,,	1·8
Total O_2 at 40 ,,	143 c.mm.
Chenopodium Bonus-Henricus.	Dry weight 49 mgm.
Q_{O_2} 7–15 min.	8·9
,, at 30 ,,	5·8
Total O_2 at 30 ,,	199 c.mm.
Chenopodium Bonus-Henricus.	Dry weight 4·9 mgm.
Q_{O_2} 7–15 min.	17·8
,, at 30 ,,	4·3
Total O_2 at 30 ,,	33 c.mm.

The maximum Q_{O_2} obtained is 18, compared with a Q_{O_2} of 20 as originally measured by hæmoglobin. These new findings confirm the former experiments carried out with hæmoglobin as a means of measuring oxygen, and in addition show that the isolated chloroplast in light can evolve oxygen at a high pressure. The chloroplast then, with ferric oxalate as a hydrogen acceptor, behaves in a similar way to the whole cell as regards the production of oxygen during photosynthesis.

R. HILL.
R. SCARISBRICK.

Biochemical Laboratory,
Cambridge.
Molteno Institute,
Cambridge.

---

[1] Hill, R., *Proc. Roy. Soc.*, B, **127**, 192 (1939).

[2] Hill, R., and Scarisbrick, R., *Proc. Roy. Soc.*, B (in the press, 1940).

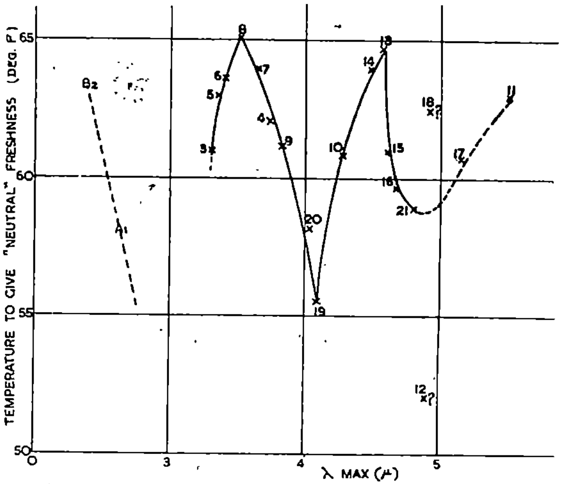
Radiation and 'Stuffiness'

WHILE difficult to define, the sensation of 'stuffiness' is easily recognized subjectively by everyone. Since the sensation can be caused by overheating, it is essential in work on stuffiness to make sure that the human subjects of the experiment are comfortable as regards warmth.

Following the procedure of earlier investigations in the field of human comfort, a numerical scale, the substantial linearity of which has been demonstrated statistically, was allotted to the various comments on sensations of stuffiness and freshness expressed by the subjects. The reactions of 'sessions' of about ten people each, tested separately, could then be averaged. By such methods it has been shown that sensation of stuffiness increases, *ceteris paribus*, with air temperature, according to a definite smooth curve.

An experimental gas fire has been built consisting of a blackened iron plate 14 in. × 16 in. with nine chromel alumel thermocouples embedded in it at strategic points. Its temperature can be varied over a wide range by control of the gas rate, and can be measured by means of the thermocouples. Spectrometric investigations have shown that the fire approximates to a 'black' or 'grey' body, and confirmed the wave-lengths of maximum energy calculated from temperature measurements.

Although in an incomplete state because of the War, the results so far obtained may be of interest. They suggest that 'stuffiness' is associated with values of λ max. of about 3 μ, 4·1 μ and 4·8 μ, with regions of freshness in between, as shown in the accompanying graph; where a low temperature for 'neutral' freshness, that is, neither fresh nor stuffy, means a wave-length associated with stuffiness and vice versa. With the longer wave-lengths, the quantity of radiation is smaller, the subject nearer to the fire, and therefore less evenly warmed by it, and the results more erratic. The numbers of the points indicate the order in which they were obtained.



RELATION BETWEEN SENSATIONS OF FRESHNESS AND STUFFINESS AND PEAK WAVE-LENGTH OF RADIATION. TOTAL, MORE THAN 200 VOTES. POINTS *A* AND *B* WERE OBTAINED WITH A DIFFERENT TYPE OF FIRE. - - - -, PORTION OF CURVE NEEDING FURTHER DATA.

Sir Leonard Hill[1] has given reasons for believing that nose closing, which may be a cause of stuffiness, is associated with radiation which does not penetrate the stratum corneum, though his views are not yet generally accepted[2]. Taylor[3] has given data on the infra-red absorption spectrum of the stratum corneum, showing the hydroxyl group absorption bands at about 3 μ, 4·7 μ and 6 μ. It is tempting, therefore, to associate the stuffiness bands at 3 μ and 4·8 μ with the absorption bands at 3 μ and 4·7 μ. Examination of Taylor's curves suggests that the use of a narrower spectroscope slit (he used 0·01 in.) might show an absorption band between 4·1 and 4·2 μ. Preliminary experiments have increased the probability of an absorption band at 4·15 μ.

K. W. YARNOLD.
H. D. N. FITZPATRICK.

The Gas Light and Coke Co.,
Watson House,
Townmead Road, London, S.W.6.
May 28.

---

[1] Hill, L., *Brit. Med. J.*, i, 977 (1939).

[2] Dufton and Bedford, *J. Hygiene*, **33** (4), 476 (1933). Winslow, *Amer. J. Hygiene*, **20**, 195 (1934). Lehmann, *Arbeitsphysiol.*, **10** (4), 418 (1939).

[3] Taylor, *Proc. Roy. Soc.*, A, **142**, 598 (1933).

Types of Californian Miocene Foraminifera

Following upon the review by "A.M.D." of Dr. R. M. Kleinpell's monograph on "Miocene Stratigraphy of California" in Nature of December 23, 1939, p. 1030, it may be of interest to note that the topotype material with the actual described types referred to by the author of the above work have now been deposited by me in the micropalæontological collection of the Stanford University.

On p. 21 Dr. R. M. Kleinpell refers to my contribution, "Foraminifera from the Tertiary of California", 1900, *Proc. Calif. Acad. Sci.*, Geol., 1, 241–258, pls. 29, 30 (1900) as the first description of Californian Foraminifera, as follows:

"Topotype material from Chapman's locality has not been obtained. As it is impossible to examine his original material, all synonymy is based on comparisons with his figures".

At the time of publication (1900) I was in communication with Dr. J. C. Merriam—who had forwarded me the foraminiferal marl through my late friend, Prof. Rupert Jones—with regard to depositing these original types in a permanent museum in America. On my removal from London to Melbourne, to take up the position of State palæontologist, I was apparently lost to sight or memory by the American palæontologists concerned, although actively publishing in the meantime. It was only lately, however, since the publication of Dr. Kleinpell's work, that I have been able, through him and Prof. Hubert G. Schenck, finally to deposit the types of this original sample, which have now a historic interest, labelled "From a well in Santa Clara Co., California" in the Stanford University.

Inter alia, may I point out that by an oversight the reviewer remarks that in the above work of Dr. Kleinpell's "there do not appear to be any new species", whereas that author has described sixty-six new species and varieties.

Frederick Chapman.

Crohamhurst,
17 Threadneedle Street,
Balwyn, E.8,
Melbourne.

I acknowledge the correction in Mr. Chapman's last paragraph of an unfortunate error, partly due to (though not excused by) the want of any typographical distinction in Kleinpell's book between new specific names and others.

A. M. D.

Phosphate Separation in Qualitative Analysis

In ordinary elementary qualitative analysis, it is usual to remove phosphoric acid from solution as ferric phosphate by dropwise addition of ferric chloride under certain conditions after removal of Group I as chlorides and Group II as sulphides. Zirconium phosphate is well known to be insoluble in acid solution and it appeared that, as an alternative method, phosphoric acid might be removed by addition of a soluble zirconium salt. The following scheme has been found to work well with elementary students in our laboratories.

As usual, the filtrate from Group II is boiled until free from hydrogen sulphide and a few drops of concentrated nitric acid are added. An acid solution of zirconium nitrate is added dropwise until further precipitation ceases; the whole is warmed and the insoluble zirconium phosphate filtered off. To the filtrate a further drop of zirconium nitrate is added and, if no precipitate forms, all the phosphate has been removed. Ammonium chloride and hydroxide are now added as usual, *the solution well boiled* and filtered.

The *filtrate* will contain any members of Group IV (Zn, Mn, Ni, Co), Group V (Ca, Sr, Ba) and Group VI (Mg, etc.) originally present and may be proceeded with in the ordinary way.

The *precipitate* contains the excess zirconium with any iron, chromium or aluminium originally present. It is boiled with sodium hydroxide, which extracts any aluminium; on filtration the filtrate is neutralized with acid and aluminium precipitated as usual with ammonia. The residue, if coloured brown, contains iron. In any event, water and sodium peroxide are added to oxidize the chromium, which passes into solution as chromate. After filtration the insoluble portion is extracted with dilute acid and the presence of iron confirmed.

The presence of chromate in the filtrate should likewise be confirmed lest any titanium in the zirconium salt should yield coloured pertitanate, which might either be mistaken for or serve to mask any chromate.

The foregoing method appears to be somewhat more straightforward than the usual procedure and is more easy to explain chemically to the elementary student than the usual method.

A disadvantage lies in the cost of the pure zirconium nitrate solution. But as zirconia is relatively inexpensive, and the presence of hafnium is immaterial, since it behaves exactly like zirconium in these reactions, it should not be difficult to place suitable solutions of the nitrate on the market at a reasonable cost, provided a sufficient demand arose.

It is, of course, important that the zirconium salt shall be pure. By spectroscopic analysis we have invariably found aluminium to be present both in zirconia and in various zirconium salts purchased from reputable firms. In our experiments, therefore, a solution of the nitrate was boiled with excess sodium hydroxide, the precipitate washed repeatedly by decantation and allowed to settle over night. The suspension was then dissolved by warming with half its volume of diluted nitric acid (1 : 1) and the resulting solution was ready for use.

J. Newton Friend.
Reece H. Vallance.
H. J. G. Challis.

Central Technical College,
Birmingham.
June 20.

Swelling of Wood Charcoal: Experiments with a New Silica Extensometer

An all-silica extensometer was made to the senior author's design by E. L. Mays, with the object of overcoming certain difficulties encountered in the measurement of the linear expansion of wood charcoal by means of the metallic extensometer pre-

TABLE 1.

Charcoal used	Outgassing temperature	Differential temp. coeff. between silica and charcoal	Saturation values		
			'S' $\frac{\text{gm. alcohol}}{\text{gm. charcoal}}$	% Expansion X $273/T$	Molecular expansion $MX/S \times 273/T$
α	1000° C.	—	0·147	0·139	28·7
β	560° C.	$2{\cdot}82 \times 10^{-6}$	0·121	0·377	92·9
γ	400° C.	$7{\cdot}02 \times 10^{-6}$	0·144	0·704	180·0

TABLE 2.

Charcoal	s/S	$\log p/P$	$x \times 273/T$	x/x_{α}	$d(Mx/s)/dx$	S	$d(Mx/s)/dx \times S$
α	0·90	$\bar{1}{\cdot}50$	0·113	1·0	150	0·147	22·1
β	0·90	$\bar{1}{\cdot}39$	0·227	2·0	225	0·121	27·2
γ	0·90	$\bar{1}{\cdot}39$	0·394	3·48	230	0·114	26·2
α	0·80	$\bar{1}{\cdot}085$	0·064	1·0	205	0·147	30·1
β	0·80	$\bar{2}{\cdot}930$	0·128	2·0	260	0·121	31·4
γ	0·80	$\bar{2}{\cdot}930$	0·210	3·28	282	0·114	32·1

viously described by Bangham and Fakhoury[1]. The most important drawbacks to the metallic form are the risks accompanying outgassing at high temperatures, the difficulty of measuring the expansion on the adsorption of gases and vapours at temperatures as low as that of liquid air, and the need for investigating the expansive properties of the fatty acids, which would attack the extensometer itself.

The new form functions without knife edges by means of a plane silica spiral sealed in a vertical position from its outer end to the body of the extensometer, while its centre is directly sealed to the base of a long pointer through a U-shaped rod. The pointer moves freely in a vertical plane when subjected to a downward pressure on its base. The charcoal rod is mounted between two claws; the upper one rests against a fixed point on the body of the extensometer, while the lower one presses on the horizontal base of the pointer. The movement of the free end of the pointer is read on a calibrated scale by means of a cathetometer reading up to 0·01 mm. A special calibrating device in the form of a micrometer screw gauge was made reading up to 0·005 mm. to determine the magnification of the extensometer at different scale divisions. The magnification was about thirty times, and it proved to be uniform over a wide range.

Comparative experiments on the expansion of a certain piece of charcoal on immersion in methyl alcohol were made by both the metallic and silica extensometers, which proved the correct behaviour of the latter.

Preliminary experiments were made to test the expansive properties of gases and vapours at the temperature of liquid air. Methyl alcohol caused an expansion which amounted to at least half its value at 18° C. (0·58 per cent), though it was still far from saturation. Hydrogen, on the same piece, gave a fairly measurable expansion which increased gradually with the increase of pressure, amounting to 0·115 per cent at atmospheric pressure. Carbon dioxide, however, seemed to give no expansion at liquid air temperature; but it gave an expansion amounting to 0·42 per cent at − 78° C.

Expansion experiments were also made on formic acid. A certain piece of charcoal (γ), which gave a linear expansion of 0·704 per cent by saturated methyl alcohol vapour at 0° C., gave an expansion of 0·923 per cent on saturation with formic acid vapour at the same temperature. Unfortunately the sorption values could not be calculated with the present data at hand owing to the variation in the degree of association of formic acid molecules at different vapour pressures. As soon as these are obtained, the molecular expansion values will be available.

Measurements of the linear expansion of some wood charcoal specimens, supplied by Messrs. Becker and Co., on the adsorption of methyl alcohol revealed some interesting results. Tables 1 and 2 show some of the results obtained for three pieces of the above variety. Those of charcoals "β" and "γ" were obtained by the silica extensometer, while those of charcoal "α" were obtained by a metal extensometer, the magnification of which was 130.

It can be seen from Table 1 that:

(1) With the rise of outgassing temperature, the molecular expansion of charcoal seems to decrease. Such an observation needs further verification on one and the same piece of charcoal, differently treated, a problem which is under investigation.

(2) The charcoal which has a higher temperature coefficient seems to give bigger expansion on adsorption.

It was previously shown by Bangham and Fakhoury[2] that the slope of the molecular expansion curves at high relative pressures, $d(Mx/s)/dx$, is a measure of B/Σ, where B is the incompressible cross-sectional area per gm. mol. of the adsorbate, and Σ is the available adsorbing surface. Now for the same adsorbate, we expect B to be the same at the same relative concentration, (s/S), for the different specimens of charcoal, and Σ to be proportional to the saturation adsorption values S. Therefore, the slopes of the different molecular expansion curves at the same relative concentrations would be expected to be inversely proportional to the saturation adsorption values, that is, $d(Mx/s)/dx \times S$ should be constant, an expectation which is fairly justified by the figures in the last column in Table 2.

The data in Table 2 are taken from the molecular expansion curves, semi-log. isotherms and $\log p - x$ curves for the three above-mentioned specimens of charcoal.

It is also satisfactory to see, from column 5, that within the range shown the ratio of the percentage expansion of the three charcoals remains constant at the same s/S.

In conclusion, we may add that the molecular expansion of charcoal by a series of esters is also under investigation.

N. FAKHOURY.
M. WAHBA.

Faculty of Science,
Fouad I University,
Abbassia, Cairo.
May 1.

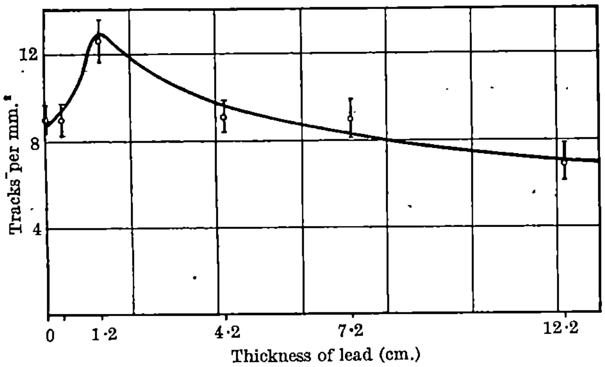
---

[1] Bangham and Fakhoury, *Proc. Roy. Soc.*, A, **130**, 81 (1930).

[2] Bangham and Fakhoury, *J. Chem. Soc.*, 1324 (1931).

Absorption of Heavy Cosmic Ray Particles

IN a previous note[1] we have described experiments with the object of obtaining information about the radiation producing the heavy particles in the cosmic rays. A set of Ilford half-tone plates (70 μ thick), sensitive to α-particles and protons and covered with thicknesses of lead up to 12·2 cm., have been exposed to cosmic rays on the Jungfraujoch and at Bristol for a period of 230 days. It was found that the primary radiation producing the tracks is strongly absorbed in air, but very little absorbed in lead, and it was concluded that the majority of tracks observed in the emulsion are produced by the neutron component of the cosmic rays.



VARIATION OF NUMBER OF HEAVY TRACKS WITH THICKNESS OF ABSORBER.

We have now measured the absorption curve in lead, on the Jungfraujoch material, in more detail and with greater accuracy. The result is shown in Fig. 1, where we have plotted the number of tracks per mm.² against the thickness of lead. Only tracks with a visible range greater than 10 cm. air equivalent have been included since a large fraction of the shorter tracks are due to radioactive contamination. The curve shows a maximum at about 1·2 cm. lead.

It follows from this result that there are at least two components of cosmic radiation producing heavy tracks. The first component is very little absorbed in lead and consists very probably of neutrons. The second component has a transition curve in lead very similar to that of the soft radiation. It has a maximum coinciding precisely with the Rossi maximum and falls rapidly to a small value within 5 cm. of lead. We therefore conclude that the soft radiation (electrons and light quanta) is responsible for part of the heavy tracks and particularly for the maximum of our curve. It is plausible to assume that the process by which these tracks are produced is the direct nuclear photo-electric effect.

The cross-section for this photo-electric effect can only be estimated very roughly from these results for several reasons. First, the number of light quanta per cm.² min. at the Jungfraujoch is not known accurately. Secondly, since most of our tracks are passing through the whole emulsion, we do not know the actual distribution of range of our particles and, consequently, we do not know whether the bulk of our tracks originate from the lead or from the glass.

The number of soft ionizing particles at the Jungfraujoch is about 2 per cm.² min. After cascade multiplication in 1·2 cm. lead, we can assume that the number of light quanta with energies greater than 10 Mev. is about 6 per cm.² min. Assuming, further, an average range of the disintegration protons of 1 m. air equivalent, we find an average cross-section for photo-disintegration with proton emission of 10^{-25} cm.² per lead atom or SiO_2 molecule. This figure is very rough and may well be wrong by a factor 5. We may compare it with the cross-section for the photo-electric effect with neutron emission obtained by Bothe and Gentner[2] for copper and the lithium γ-rays, namely, 5×10^{-26} cm.². Our figure may seem to be rather large, especially in view of the fact that neutron emission is much more probable than proton emission, but taking into account the many uncertainties involved, it is probably a reasonable order of magnitude.

If it is true that some of the protons are produced by photo-electric effect, it must be expected that an even larger number of neutrons is produced in the same way. Since we do not know the cross-sections for the photo-electric effect for oxygen and nitrogen atoms, it is difficult to decide whether the whole neutron component of cosmic radiation can be accounted for by a photo-electric effect taking place in the high atmosphere, or whether other processes are involved in the production of the neutron component too (compare also ref. 3).

Further details will be published elsewhere.

W. HEITLER.
H. H. Wills Physical Laboratory, C. F. POWELL.
University of Bristol. H. HEITLER.

June 3.

---

[1] Heitler, Powell and Fertel, NATURE, 144, 283 (1939).

[2] Bothe and Gentner, *Z. Phys.*, 106, 236 (1937).

[3] Bethe, Korff and Placzek, *Phys. Rev.*, 57, 573 (1940).

Specific Ionization of Cosmic Ray Particles

MEASUREMENTS of the specific ionization of cosmic ray electrons with energies between $0 \cdot 1 \times 10^6$ ev. and 30×10^6 ev. have been made by Corson and Brode[1] by counting droplets on photographs taken with a counter-controlled cloud chamber using a delayed expansion. They established the existence of a minimum ionization at about $1 \cdot 5 \times 10^6$ ev. and a logarithmic increase in ionization with energy beyond this minimum. Using essentially the same method, I have measured the specific ionization of cosmic ray particles over the energy range $2 \times 10^6 - 6 \times 10^9$ ev.

The track photographs were classified in the following way:

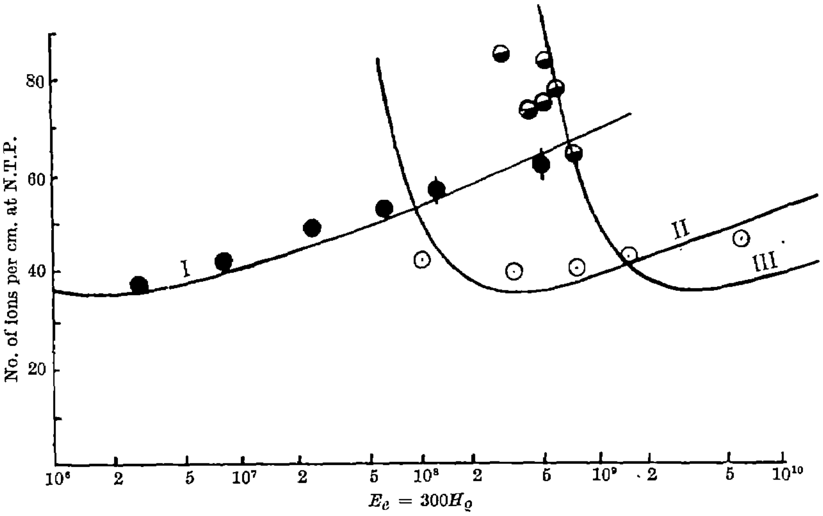
(1) In general, all particles in showers were assumed to be electrons. The exceptions were a few particles of energy greater than 10^8 ev. which showed an ionization markedly less than that of electrons of the same energy, and were therefore considered to be mesons responsible for the production of 'knock on' showers. Three particles, each from a separate shower, were taken as mesons out of forty measured showers for this reason.

(2) Single particles with energy less than 40×10^6 ev. not exhibiting heavy ionization were taken as electrons. Mesons of this energy would be recognizable because of their heavy ionization.

(3) Single particles in the energy region 2×10^8 ev. to 7×10^8 ev. showing markedly heavy ionization were taken as protons.

(4) All other single particles were assumed to be mesons, although certainly a small fraction were protons.

The theoretical curves for electrons, mesons ($M = 170\ m$) and protons are shown in the accompanying graph. The experimental results for electrons show good agreement with the theory over the



ENERGY IONIZATION CURVES FOR ELECTRONS (I), MESONS (II), PROTONS (III).

● = ELECTRON
○ = MESON (M = 170 m)
◒ = PROTON

observed range, that is, between 2 × 10^6 ev. and 5 × 10^8 ev., both as regards absolute value and variation with energy.

For mesons, the agreement with theory is not as good. However, the results do show a small rise of ionization with energy, though not as much as is expected. Possibly the errors of the curvature measurements may be the cause of this discrepancy. Since the protons above 2 × 10^3 ev. ionize less than mesons of the corresponding energy, the relatively low observed value in the highest energy group may possibly be explained as due to some protons being included in the group. Unfortunately, no meson track was observed with a momentum low enough to allow a reliable mass determination.

Among 3,000 tracks, eight recognizable proton tracks (all positive) have been observed. The observed values of the mean specific ionization on each individual proton track are shown as half-shaded circles, and show a satisfactory agreement with the theoretical curve. No alpha particles or other multi-charged particles were observed, nor any deuterons.

A detailed account of the investigation will be published elsewhere.

Physical Laboratories, R. L. SEN GUPTA.
University of Manchester.
June 6.

[1] Corson and Brode, *Phys. Rev.*, **53**, 773 (1938).

Current Distribution and Throwing Power in Electrolytes

THERE are two interesting aspects of the distribution of a direct current flowing between soluble metal electrodes in an aqueous electrolyte confined in an insulating vessel. Theoretically the problem appears to be soluble, ideally at least, by classical potential theory using the electrochemical theory of the anode and cathode fall. The distribution is of great practical importance in attaining uniform deposits on curved surfaces and in holes, and in avoiding heavy deposits on sharp edges and projections.

Although the current distribution between a common anode placed between two equal cathodes at the same potential but at variable spacing has been extensively investigated experimentally, G. E. Gardam[1] appears to be the first to attempt a theoretical treatment. He showed that the ratio of the currents flowing to each cathode can be calculated in terms of the dependence of the cathode fall on the current density, the conductivity of the electrolyte, and the electrode spacings, for the case of a uniform field corresponding with the experimental arrangement of Haring and Blum[2]. This theory also predicts the relation between the cathode currents and the throwing power[3], which latter is a function of the ratio of the weights of the deposits and the electrode distances. A good agreement is reached with both his own experimental results and those of other investigators.

Recently the current distribution in electrolytes for various electrode systems giving non-uniform fields has been examined theoretically by C. Kasper[4] by applying potential theory; the important effects of potential falls at the electrodes are, however, neglected.

A new theoretical and experimental investigation of the current distribution between plane electrodes at variable spacings in a non-uniform field has been carried out in an attempt to remedy this defect. The experimental arrangement consists of an anode, a main cathode with a hole in the centre from which, on the side opposite to the anode, a rubber tube extends, ending in a small subsidiary cathode (at the same potential as the main cathode). The current to the subsidiary electrode is calculated approximately from the sum of two potential terms. The first is the potential at the centre of the hole determined by the potential field between the three electrodes; this field problem is similar to that in a cathode-ray oscillograph[5]. The second is equal to the difference between the two cathode falls. Allowance is made for the resistance of the electrolyte between the two cathodes. Assuming the usual logarithmic relation between the cathode fall and the current density, it is found that the ratio of the subsidiary to the main cathode current decreases with increasing distance between the cathodes and with increasing current to the main cathode, the rate of change being very rapid at small spacings. Furthermore, this ratio is independent of the distance between the anode and the main cathode over a wide range.

Using copper electrodes in neutral and acid solutions of copper sulphate, these theoretical predictions are found to be satisfactorily confirmed by the present experiments, in which measurements of the electrode potential fall by means of probe electrodes are introduced. A detailed report of these investigations will be published later. A. v. ENGEL.

Inorganic and Physical Chemistry Department,
Imperial College of Science and Technology,
London, S.W.7. May 28.

[1] Gardam, G. E., *Trans. Far. Soc.*, **34**, 698 (1938).
[2] Haring, H. E., and Blum, W., *Trans. Amer. Electrochem. Soc.*, **44** 313 (1923).
[3] Field, S., and Weill, A. D., "Electro-Plating" (London, 1938).
[4] Kasper, C., *Amer. Electrochem. Soc.*, **77**, preprint 28 (April 1940)
[5] Ollendorff, F., "Potentialfelder der Elektrotechnik" (Berlin: Springer 1932).

RESEARCH ITEMS

Native Medicine in Portuguese Africa

In a study of native conceptions of disease and healing in Portuguese Africa (Guinea, Angola and Mozambique) by Luiz de Pina (*Scientia*, 67; 1940) it is pointed out how close is the resemblance in basic ideas not only with those of primitive peoples generally, but also of the backward European peasantry. In Portuguese Africa illness may be attributed to any of three causes: (1) the introduction of a strange body or a spirit or soul of another person, often of a sorcerer, into the body of the sick person; (2) the hostile action of a *fetiço* (enchantment) by another person or object; (3) the vengeance or punishment of the gods, idols, etc. While any one of these may be operative, it is the idea of *fetiço* which dominates the native mind. The nature of *fetiço* is incorrectly presented by many writers. It is not merely an object, it also covers a charm, spell, a bewitching, a divination or a curse, and it may cause a tempest, a disastrous war, toothache, illness or any like misfortune. Its author, if a living person, is condemned to death, but the responsibility may rest also with an object, an idol, or a divinity. Usually, however, it is a wizard or witch. These are both loved and execrated according as their powers are exercised in the detection of, or the causing of, *fetiço*. Among certain African peoples the belief in a supreme and inferior deities, represented by idols, more or less crude, may be found, but there, it is to be noted, the powers of the supreme deity are less than those of the spirits controlled by the sorcerers, since the supreme deity exercises no influence over the affairs of this world. Some of the lesser deities are concerned only with certain specific diseases, and some of them are venerated in sacred places and have a priesthood attached to their cult. The practitioners concerned in the medical art are doctors, sorcerers and midwives. The doctor, who is both surgeon and physician, combines with his functions those of the sorcerer, as the sorcerer does those of the doctor. The basis of the healing art is magic, which in the detection and punishment of the individual responsible may be made the instrument of private vengeance. After the sorcerer comes the physician, who among his medicaments draws upon the wide variety of simples and drugs provided by the indigenous flora.

Continuity of Culture in Scandinavia

Two contributions appearing in *Antiquity* of June 1940 deal with Scandinavian cultural survivals from prehistoric or earliest times. A. W. Brøgger sketches the development of Norwegian cultural history "from the Stone Age to the Motor Age". Up to a century ago on a farm was a stone bearing the runic inscription "Eiliv Elg carried fish in Rausjøen", indicating that in the days of Olaf the Holy, as in modern times, fry was transferred to the mountain tarns. Only fragments of the saga from the Stone to the Motor Age have been found; but the lines may be traced in the foundations of folk-culture. Two animals dominated the annual culture, the stag and the seal, supplemented by the elk and the reindeer. The first change was the introduction of domesticated animals and corn four to five thousand years ago. Henceforth peasant culture is a combination of hunting and farming. With the Iron Age, peasant culture incorporated iron production from bog ores and native rock-species, while the introduction of the iron axe provided an efficient weapon against the forest. The foliage knife, which afforded fodder for the cattle, and the scythe are the fundamental elements in the emergence of the Norwegian farm, based upon cattle breeding, which was the social, economic and technical unit, with the family as its active centre. The Iron Age also brought a new type of boat which made possible the development of the maritime culture of the Vikings. A rural industry of Jutland, of which an account is given by Axel Steensberg, produces a hand-made pottery, small black vessels of great beauty which, notwithstanding the introduction of the potter's wheel into Denmark at the close of the Iron Age, has survived down to to-day.

Biology of the Silverfish Insect

An important study of a silverfish, *Ctenolepisma longicaudata*, first described in 1905 from S. Africa, and since found to be widely distributed, has been made by Eder Lindsay (*Proc. Roy. Soc. Victoria*, 52 (N.S.), 35; 1940). The species, which is becoming a pest of increasing importance in Australia, since it feeds upon stored food materials as well as upon paper, cotton and artificial silk, has a life-history spread over about seven years, during four of which it is mature. Its temperature tolerance ranges from 11° C. where development stops and the insect becomes torpid, to an optimum at 25° C., temperatures higher than which cannot long be endured. In dry air silverfish die rapidly, and since they take no liquid, their moisture content is derived from food and oxidation of food-stuffs, as well as from moist air. The rate of egg-laying is low, but the long life of the adults leads to rapid increase in numbers: if each female laid 56 eggs a year and there were no fatalities, the progeny of one pair would lay 470,000 in the seventh year. Control is exercised by toxic sprays which must come in contact with the insect, and is most effective when carried out at night; but the nature of the life-history, feeding habits, and temperature and moisture tolerance, associated with the absence of enemies, suggests that control measures to be reasonably effective must be applied continuously.

Madreporarian Corals of the "Discovery" Expedition

J. Stanley Gardiner describes a small collection from a number of localities of Madreporarian corals with an account of variation in Caryophyllia (*Discovery Rep.*, 18, 323–339; 1939). *Flabellum curvatum*, obtained in seventeen dredgings, was remarkably widely distributed. Although the only common feature in these localities is the low temperature, there was no character found in this species which might be supposed to be related with this factor, and the specimens presented no difference in texture compared with species from the Indian Ocean. Very few positive conclusions emerge from the review of the variation in Caryophyllium, which is a cosmopolitan genus and usually inhabits waters deeper than 50 fathoms. The study of ecological conditions with regard to variation does not help much owing to scanty knowledge of the natural habitats. Fossil forms are common in tertiary deposits and have also been described from the cretaceous. The author regards it as clear that many, perhaps most, fossil forms of Caryophyllia still continue to exist to-day.

Diffusing Factors

DIFFUSING factors which increase the permeability of the skin to injected fluids and particles can be obtained from such diverse sources as spermatozoa, testis, bacterial cultures, malignant tissues, leeches and snake and spider venoms. For example, a mixture of Indian ink and testicular extract is injected intracutaneously into the shaved back of a rabbit and a control injection of Indian ink in saline is also made. The area over which the particles of Indian ink spread is increased by high dilutions of the testicular extract. The passage of substances such as dyes, hæmoglobin and diphtheria antitoxin is influenced by the diffusing factor. Madinaveitia and co-workers, in a series of papers (*Biochem. J.*, 34, 613, 621 and 625; 1940), discuss a possible theoretical mode of action for the diffusing factor. They also show that it can be separated from the proteases of a *Cl. Welchii* filtrate, and find that in a preliminary concentration from testicle powder, mucinase activity seems to run parallel with diffusing factor activity.

Inclusions in the Cells of Virus-infected Plants

F. M. L. SHEFFIELD, of Rothamsted Experimental Station, has published an informative summary of the effects of plant virus diseases on the cells of their hosts (*J. Roy. Micro. Soc.*, 59, 149–161; 1939). Descriptions of normal and diseased cells indicate the general effects, such as the increase in protoplasm content, which often accompany virus attack. Amorphous inclusions are shown to be composed of protoplasm, and to contain oil globules and chondriosomes. They are of two morphological types, namely, granular and amœboid. Crystalline inclusions often accompany the amorphous products. The presence of inclusions indicates a relatively high concentration of virus within the cell. Amorphous inclusions may give rise to the crystalline type, and the review indicates a high probability that virus protein and both kinds of inclusion are really different manifestations of the same thing. The knowledge here collected is useful equipment for the research worker, but teachers of plant pathology will also find it invaluable.

Strawberry Yellow-edge Virus

A SHORT paper by W. F. Cheal in the *Gardeners' Chronicle* of March 2 describes field trials on the planting of strawberries free from yellow-edge virus. Plots in four centres of the Isle of Ely were established at varying distances from existing plantations which contained diseased plants. The virus disease was very rapidly transmitted to those healthy plants which were within a quarter of a mile of the diseased fields, but no transfer took place when they were separated by a greater distance. It therefore appears that the use of disease-free stocks in strawberry-growing areas is useless, unless they are planted an adequate distance, say a mile, from the existing fields.

Cell-Division

E. W. Sinnott and R. Black (*Proc. Nat. Acad. Sci.*, 26, 223–227; 1940) have shown that the orientation of the new cell wall between daughter cells is determined early in the life of the mother-cell by the cell body. They studied vacuolated plant cells and found that from very early prophase the cytoplasm tends to aggregate into a plate of more or less fused strands where the future cell wall will be laid down. They consider that the factors affecting the orientation of the division act on the cell as a whole and not only on the nucleus.

Translocation in Wild Grasshoppers

M. J. D. WHITE (*J. Hered.*, 31, 137–140; 1940) reports the finding of several individuals of *Metrioptera brachyptera* (Tettigonidæ) in the New Forest which possess a reciprocal translocation between two pairs of chromosomes, III and IV. The first individual was found in 1937 and others were found in 1939, therefore the variety has been able to become well established. Usually chromosomes III and IV form separate bivalents, but occasionally a chain of four chromosomes is found. The small proportion of multiple configurations is possibly due to localization of chiasmata normally present in this species.

Polyploidy in Paramecium

TZE-TUAN CHEN (*J. Hered.*, 31, 175–196; *Proc. Nat. Acad. Sci.*, 26, 231–246) shows that different races of *Paramecium bursaria* differ in the size of the micronuclei. These differences are correlated with the chromosome number. Race *Fd* has about 80 chromosomes while others have several hundreds of chromosomes. Polyploidy probably originates from the fusion of the two pro-nuclei during conjugation. No interference with conjugation is caused by differences in chromosome number. After conjugation the two conjugants possess the same number of chromosomes. Animals without micronuclei can conjugate with animals possessing micronuclei. The behaviour during conjugation of *Paramecium bursaria* is analysed. Three animals have been observed to conjugate together at one time, but exchange of pro-nuclei only takes place between two of the conjugants.

Nature of Ore-forming Fluids

IN a Supplement to *Economic Geology* (34, 197–358; 1940), L. C. Graton gives a valuable summary of present knowledge and theory as to the origin, state, composition, migrations and effects of the mobile medium which transports mineral-forming materials and deposits them to form the hypogene epigenetic ores. The survey starts from the arguments and conclusions of Fenner, Bowen, Ross and Schaller in the well-known "Lindegren Volume", and it is shown that widely differing and irreconcilable hypotheses are currently held and are causing confusion at a stage of the science when some clarification might reasonably be expected. Reasons for this situation are suggested, but it is nowhere indicated that one possible reason may be that some ores at least may not originate within the magma which most authors assume to be the unquestioned source. The dominant agent of hypogene ore genesis is thought to be a late-magmatic hot alkaline liquid extract. Derivation by boiling from the normal magma is regarded as quantitatively insignificant. The contrast is emphasized between the confined conditions in depth where magmatic differentiation is supposed to be accomplished and the special superficial conditions where alone observation is possible of magma in action. It is thought that gas is far inferior to liquid for transporting mineral solutes, and pneumatolysis is therefore regarded as of slight importance except close to the surface. The weak point in all hypotheses of ore genesis from magma is the difficulty of suggesting a satisfactory mechanism of separation to account for the observed sequences of ore deposition, and one of the chief merits of Graton's review is that he frankly exposes this and other difficulties wherever they occur.

Crystalline Lactic Dehydrogenase

Straub (*Biochem. J.*, 34, 483; 1940) has added lactic dehydrogenase to the list of proteins having enzyme activity which can be obtained in crystalline form. The reaction: lactic acid + cozymase $\rightleftharpoons$ pyruvic acid + reduced cozymase is catalysed by lactic dehydrogenase, and the purification of the enzyme has been followed by measurement of the oxygen uptake occurring when lactic dehydrogenase is added to a mixture of lactic acid, cozymase, methylene blue, cyanide and flavoprotein, which forms a complete system for oxidizing lactic acid. The enzyme can be extracted from bullocks' hearts with water and adsorbed on to calcium phosphate gel. After elution with pH 7·2 buffer, purification by fractional precipitation with acetone and then ammonium sulphate is carried out. Finally crystallization is accomplished by gradually increasing the concentration of ammonium sulphate from 0·4 to 0·5 saturation. Lactic dehydrogenase is shown not to be identical with malic dehydrogenase.

Directed Valency

The two methods of studying problems of directed valency, namely, the Heitler–London method of localized electron pairs and the Hund–Mulliken method of molecular orbitals, both have the defect of not giving (*a*) all the possible stable electron groups which give rise to directed valency, and (*b*) the possibilities of multiple bond formation. A new method, based on group theory, is put forward in a paper by G. E. Kimbell of Columbia University (*J. Chem. Phys.*, 8, 188; 1940). Any set of equivalent directed valency orbitals is representable by a characteristic symmetry group and, if the operations of this group are performed on the set, a (usually) reducible representation can be obtained, and, from the character table for the particular group, resolution into component irreducible representations can be carried out. Thus the possibility of covalent bond formation in any spatial arrangement of a given electronic configuration can be tested. Moreover, the possibilities of double- and triple-bond formation can also be worked out. Results of calculations of all configurations of from 2 to 8 s, p and d electrons are given. The molecules which are discussed in detail are: H_2O, H_2S, nitrosyl halides, NO_2', $Ag(NH_3)_2+$ and I_3' ions, CO_2, SO_2 (co-ordination number of central atom, 2); SO_3, SO_3'' (co-ordination, 3); XO_4 ions, $SiCl_4$, $Ni(CN)_4''$, $Ni(CO)_4$, ICl_4' (co-ordination, 4); PCl_5, $Fe(CO)_5$, IF_5 (co-ordination, 5); $Fe(CN)_6''''$, $Fe(CN)_6'''$, SF_6, SeF_6, TeF_6, $SbBr_6'''$, (co-ordination, 6); ZrF_7''', and TaF_7'' (co-ordination, 7); $Mo(CN)_8''''$, OsF_8 (co-ordination, 8). For several symmetry types there are no known molecular or ionic examples, and invariably this is because these symmetry types are shown theoretically either to have great instability or to be much less stable than other possible configurations of the same co-ordination. The geometrical arrangements of the various possible electronic configurations are discussed. The structures deduced from this method are in agreement with those ascertained by the usual methods of investigation; but the method is also capable of predicting structures which so far have not been determined experimentally; for example, the OsF_8 molecule should be a face-centred prism, and the unknown ions $Fe(NH_3)_4{+}{+}$ and $Fe(CN)_4''$ should be irregular tetrahedra.

Diborane diphosphine

An interesting compound, described by L. Gamble and P. Gilmont (*J. Amer. Chem. Soc.*, 62, 717; 1940), is diborane diphosphine, $B_2H_6.2\,PH_3$, which is formed from diborane B_2H_6 and phosphine above −30° in the gas, and above −110° in the liquid phase. It is a white crystalline solid which dissociates above −30° into diborane and phosphine, thus behaving differently from the ammine compound $B_2H_6.2\,NH_3$. It dissolves with difficulty in liquid ammonia, and above −60° the solution evolves phosphine; on evaporation a white solid, $B_2H_6.NH_3.PH_3$, probably $NH_4{\cdot}(BH_3PH_2BH_3)$, remains, hence the formula of diborane diphosphine could be written $PH_4\,(BH_3PH_2BH_3)$. The salt-like nature of the compound is, however, not well defined, as it will dissolve in liquid ammonia at −75° without the liberation of phosphine, unlike a true phosphonium salt, which liberates phosphine and forms an ammonium salt.

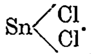
A Photographic Survey of Galactic Clusters

George Alter has published a paper, the first of a series, describing the method of work with the Mond astrograph of the Norman Lockyer Observatory, Sidmouth, and also the application to N.G.C. 581 (M. 103) (*Mon. Not. Roy. Astro. Soc.*, 100, 5; March 1940). The Mond astrograph has four telescopes for photographic purposes, and a full description of the instrument has already appeared in "Handbook of the Norman Lockyer Observatory". In the standard working scheme, Camera *A* serves for counting star clusters and determination of cluster diameters. Camera *B* is used for the determination of photovisual magnitudes, without colour screen, by using Ilford Hypersensitive Panchromatic plates, which give the photovisual scale almost perfectly. Camera *C* gives the photographic magnitudes by using Barnet Super Press plates. Camera *D* completes the magnitude series for the brighter stars by shorter exposure time. The magnitude determinations are made by exposures of 1h. on the cluster and 1h. on the north polar sequence on the same plate. Camera *B* has a second cluster plate to detect variables, and in this way a source of error is excluded as all photographs are exposed under the same conditions of atmosphere. A detailed account is given of the work, and the results of the investigation of N.G.C. 581 are as follows: Pleiades type, star number 44, angular diameter 6·8′, distance 2040 (± 180) parsecs, linear diameter 4·5 parsecs.

STEREOCHEMICAL TYPES AND VALENCY GROUPS*

THEORY and experiment agree that the arrangements in space of the covalencies of a polyvalent atom, while they are subject, from a variety of causes, to small variations seldom exceeding 5°–10°, tend to conform to a quite limited number of types. Recent developments of mathematical physics have made it possible to calculate how these types are related to the electronic groups occupied by the valency electrons.

It is, however, not always possible to say which these sub-groups are, and it is in any event desirable for the chemist that he should be able to relate the spatial grouping to some more familiar property of the atom. The property here used is the size (in G. N. Lewis's sense) of the valency group of the central atom, and the number of shared electrons which it contains, together with that of the preceding (unshared) electronic group in the atom. The experimental results show the following relations.

When the valency group is less than 8 we have with a covalency of 2 a linear structure (as in Cl-Hg-Cl): with a covalency of 3 a plane structure with equal angles of 120° (BF_3): with 6 electrons of which only 4 are shared, as in the vapour form of stannous chloride, probably a triangular molecule  $Sn\begin{smallmatrix}Cl\\Cl\end{smallmatrix}$.

With a complete octet the arrangement can be either tetrahedral or planar. When the covalency is less than 4 (partially shared octet), it is always derived from the tetrahedron, as in the triangular OH_2 and the pyramidal NH_3. The fully shared 4-covalent octet can be of either form. When the preceding electronic group, n in the grouping (n) 8, is 2, 8, or 18, it is always tetrahedral. In the transitional elements where $8 < n < 18$, it is found that if n is not much more than 8 the structure is tetrahedral, and if it is not much less than 18, planar; but the two series overlap, and for values of n of 13 to 15 and perhaps 16, both forms occur.

When the valency group is 10 with at least 2 of them (the 'inert pair') unshared, the structure of a dicovalent atom (as in $M[I_3]$) is linear; that of the 3-covalent (as in $C_6H_5.ICl_2$) is unknown, while that of the 4-covalent decet is found in the thallous and plumbous compounds to be planar, but in tellurium tetrachloride may possibly be a distorted tetrahedron.

The peculiar 4-covalent duodecet in $M[ICl_4]$ is planar.

Covalency 5. So far as it has been examined (four different types), this has always been found to give a trigonal bipyramid.

Covalency 6. Three structures are theoretically possible: a trigonal prism, a trigonal antiprism, and a regular octahedron. Experimentally the structure is always found to be the octahedron, except in a few giant molecules such as those with the nickel arsenide lattice. The regular octahedron has been found with practically every possible size of the preceding group, as well as with the 'inert pair' of electrons.

A covalency of 7 has been examined in three or four compounds, which have two different structures, one derived from an octahedron and the other from the trigonal prism.

Covalency 8. The only compound examined, $K_4\,[Mo(CN)_8]$, is found (rather unexpectedly) to have a dodecahedral arrangement of the 8 CN groups.

Nearly (but not quite) all the structures can be even more simply related to the size of the valency group by assuming that the mean positions of the electron pairs in this group are the same whether they are shared or not, the structure being linear for 4 electrons, plane symmetrical for 6, either tetrahedral or plane for 8, a trigonal bipyramid for 10, and an octahedron for 12.

---

*Substance of the Bakerian Lecture before the Royal Society delivered by Prof. N. V. Sidgwick, F.R.S., and H. M. Powell on June 27.

CONCENTRIC CONDUCTOR TYPE OF HIGH-VOLTAGE ALTERNATORS

A PAPER on "Operating Experience with High Voltage Alternators" by W. D. Horsley, of Messrs. C. A. Parsons and Co., Ltd., which was to have been read and discussed before the Institution of Electrical Engineers, has now been published in the *Journal* of the Institution of April. It was read and discussed before five local centres at various dates, and the discussions at these centres have been included.

The first high-voltage alternator of the concentric type was commissioned in August 1928, the pressure chosen being 33 kilovolts. The earlier history of this machine and its successful operation have been fully described by C. A. Parsons and J. Rosen and was published in 1929 in vol. 67 of the *Journal*. Since it was installed at the North Metropolitan Power Station, it has worked smoothly, the maintenance costs being negligible although the conditions of operation were more difficult than the average in the early years of its life. There are now twenty-one machines of this type in service, and a review of some of the difficulties experienced is first given. The second machine built had an output of 25,000 kw. at a pressure of 33 kv., and was installed in the Brimsdown Power Station in 1932. But after being put into service, a breakdown occurred on the third day owing to the failure of a slot insulating tube and the core. This accident demonstrated the rapidity with which a bar can be replaced in the concentric type of winding. Soon afterwards, improved methods of inspection and testing, including the measurement of the dielectric losses of individual bars, were introduced, and the possibility of a faulty conductor being fitted in an alternator is now very remote.

In November 1933, a flashover took place from the end windings of the alternator to the station frame, and simultaneously a flashover to earth occurred from one terminal on the main oil circuit-breaker controlling the alternator. An examination showed that the path of the flashover in the stator windings passed through at least 4 in. of air, and it was computed that it could only have been caused by an over-potential exceeding 70 kv. The normal operating potential of the winding to earth at the point of the fault was 6·5 kv. When the flash occurred, the alternator was isolated from the transmitting system and had just been excited to normal voltage prior to being synchronized with the main busbars.

The characteristics of the voltage transformers and of the capacitance of the alternator windings and their connecting cables showed that the conditions which gave rise to the phenomenon known as neutral instability were present. It was calculated that the potential of the windings cable and switchgear could build up to 75–100 kv., which agreed closely with the value deduced from the examination of the failure from the available data.

While the satisfactory operating experience with the concentric-conductor winding proves the construction to be sound, investigations following the failure of a joint showed that a number of improvements were possible. A new technique has been developed for the making and insulating of joints. Among other improvements is the use of glass silk as an insulating material. It is also being used in place of cotton or silk for other purposes. It is more durable and will withstand a higher temperature, and the individual fibres, being solid, cannot absorb moisture.

The earthing of systems through a tuned reactor or arc-suppression coil has received great attention in Great Britain in recent years and is being given a trial on a number of systems. As the coil has a comparatively high impedance, circulating currents due to harmonics should be negligible, and therefore it would be permissible to earth the neutral point of a generator by this means.

Experience has shown that the damage which is caused by an earth fault in an alternator is small, as the differential protection trips both the main and the neutral breakers very rapidly, thus interrupting the fault circuit. A fault between phases causes greater damage, as the fault circuit cannot be interrupted, and although the field circuit may be opened rapidly, an appreciable time is required for the main flux to collapse.

Mr. Horsley concludes by emphasizing the trustworthiness of concentric-conductor alternators, and thinks that they have a promising future.

NATIONAL FRUIT AND CIDER INSTITUTE

THE annual meeting of members of the National Fruit and Cider Institute was held at the University of Bristol Research Station, Long Ashton, on June 27.

Chief among the items of interest were exhibits arranged by the Fruit Products Section dealing with methods of using fruit products to alleviate the difficulties occasioned by the sugar shortage. During the War of 1914–18, Prof. B. T. P. Barker organized a scheme for the conversion of apple juice into jelly. This work has been taken up again and extended by Mr. V. L. S. Charley, who has developed methods for concentrating fruit juices by vacuum evaporation. The acid content of the raw juice is first reduced by the use of potassium carbonate or pure chalk at a rate of 2–3 lb. per 100 gallons of juice. Acid cooking apples as well as dessert varieties can thus be converted into very sweet concentrates. The apple flavour is retained by recovering the volatile products during concentration and returning them to the concentrate. Treatment of the juice before concentration with a pectin-decomposing enzyme allows a high degree of concentration without danger of gelling, and the final product assumes the consistency of treacle, containing about 75 per cent soluble solids and 65 per cent invert sugar. One ton of cull apples produces 150 gallons of juice, which is concentrated to make 13 gallons of treacle.

Apple treacle has been successfully used as a sweetening agent for both domestic and industrial preparations such as jams, cakes, confectionery, cider and pickles. All kinds of excellent jam have been made by using half the normal amount of sugar with an equal quantity of apple treacle. The treacle itself is self-sterile and can be stored without special containers. Apple jelly is made by warming the concentrated juice with one tenth its volume of liquid apple pectin and adding a small amount of sugar. Plum concentrate has also been prepared, but its high acidity renders it less suitable for general use. A fuller account of this work appears in *Food Manufacture*, 15, 6 (June 1940) and in the Long Ashton Annual Report for 1939.

Another exhibit showed methods of maintaining the natural sugar in cider. The usual procedure is to allow the apple juice to ferment and to add sugar to the final product. By adding potassium metabisulphite as a source of sulphur dioxide and removing yeasts by centrifuging, fermentation can be suspended and much of the original sugar content retained.

A phase of the Station's work on plant nutrition was represented by an exhibition of vegetable and other crop plants suffering from manganese deficiency. This deficiency, recognizable by a chlorotic condition and yellowing of the foliage, has occurred with some frequency in oats sown on newly ploughed grassland, especially on highly calcareous soils. Garden beets, spinach beet, spinach, parsnips and lettuce have been found showing similar symptoms when grown in soil to which much lime and organic matter has been added. Successful control is being achieved in some cases by spraying the foliage with a dilute solution of manganese sulphate.

The Station plantations were open for inspection by the visitors. Considerable interest was shown in demonstration plots on which the cropping plans recommended in the Ministry of Agriculture Grow-more Bulletin No. 1 are being subjected to practical tests.

THE ENGINEERING FOUNDATION

THE annual report for 1938–1939 of the Engineering Foundation of New York forms an interesting record of a year's activity in a wide range of research projects mainly of a technical nature, associated with engineering and designed to produce results of practical value to science, industry and public welfare. These researches are carried out in collaboration with engineering and other societies and the results are published by the institutions concerned and by the technical press. The part played by the Engineering Foundation is that of receiving applications for assistance, examining the merits of the projects submitted, recommending and making grants and maintaining contact with the work while in progress.

The present report records a number of researches undertaken and in progress in conjunction with seven other corporate bodies dealing with such important subjects as soil mechanics, critical pressure steam generation, cotton seed processing, and plastic flow of concrete. On the non-technical side, the Engineers' Council for Professional Development was supported in the establishment of central and local committees to deal with such matters as the selection and guidance of engineering students, engineering schools, professional training and professional recognition, the general trend and purpose of the labours of which is towards the raising of the status of the engineering profession.

The Engineering Foundation was established in 1914 "for the furtherance of research in science and engineering or for the advancement in any other manner of the profession of engineering and the good of mankind" and has now completed twenty-five years of useful service. The occasion is celebrated by the issue of a more comprehensive record of the work done during this period which gives particulars of no less than seventy-three major researches and projects which have received grants towards a total cost of more than three million dollars. This is a very remarkable result, more particularly when it is considered that the whole machinery had to be set in motion in the early years of the period. Of the grants made, a substantial portion has been devoted to matters associated with engineering instruction and the promotion of summer schools.

The report concludes with a statement of the increasing need for research. The policy of the Board has all along been one of giving aid to promising projects which otherwise would not have been undertaken because they did not fit into the programmes of other research agencies or because of lack of sufficient funds. Universities have the facilities for investigation but there may be no funds for a particular inquiry. On the other hand, scientific societies may have funds available but be without any research facilities. Again, an industrial concern may hesitate to undertake an investigation the results of which would be used by the whole industry. Such cases provide the kind of opportunity for which the Engineering Foundation exists, in order to deal with the problems and to promote their solution. Much as has been accomplished by the prudent use of the income derived from its endowments, much more remains to be done and the opportunities for productive research are constantly increasing. The Board of the Engineering Foundation looks forward to giving assistance in the work of the future and, by the help of further endowments, to be able to extend the range of its work and its grants.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DIRECTOR OF EDUCATION—The Town Clerk, Town Hall, Stretford, Lancs. (endorsed 'Director of Education') (July 20).

DEMONSTRATOR IN PHYSICS—The Dean, Medical School Office, Guy's Hospital, Sherwood Park, Tunbridge Wells.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

University College of Wales: Welsh Plant Breeding Station. War Food Production, Advisory Bulletin No. 1: Re-Grassing, an Essential Part of Food Production. By Sir R. George Stapledon. Pp. 40. (Aberystwyth: Welsh Plant Breeding Station.) 1*s*. [106

Department of Scientific and Industrial Research. The Principles of Fumigation of Insect Pests in Stored Produce. Pp. iii+28. (London: H.M. Stationery Office.) 6*d*. net. [116

Metallurgical Abstracts (General and Non-Ferrous). Vol. 6, 1939 (New Series). Edited by S. C. Guillan. Pp. viii+684. (London: Institute of Metals.) Including 2 vols. of the "Journal", £4. [136

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 2, No. 11: Reciprocity, Part 3: Reciprocal Wave Functions. By Prof. Max Born and Dr. Klaus Fuchs. Pp. 141–146. 6*d*. Vol. 60, Part 2, No. 12: Reciprocity, Part 4: Spinor Wave Functions. By Dr. Klaus Fuchs. Pp. 147–163. 1*s*. 6*d*. Vol. 60, Part 2, No. 13: Tests of Carcinogenic Substances in relation to the Production of Mutations in *Drosophila melanogaster*. By Dr. Charlotte Auerbach. Pp. 164–173. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [136

Caradoc and Severn Valley Field Club. Record of Bare Facts for the Year 1939: a List of the More Noteworthy Observations made by Members of the Caradoc and Severn Valley Field Club and Others. Pp. 50. (Shrewsbury: Caradoc and Severn Valley Field Club.) [136

Transactions of the Institution of Chemical Engineers. Vol. 17, 1939. Pp. vi+202. (London: Institution of Chemical Engineers.) [176

Other Countries

Uganda Protectorate. Annual Report of the Forest Department for the Year ended 31st December 1939. Pp. 27. (Entebbe: Government Printer.) 2*s*. [106

Report of the Institute of Scientific Research, Manchoukuo. Vol. 4, No. 3: The Effect of Inoculation and Fertilizer Treatments on the Yield of Soybean. By Hsien Wu Cheng and Takao Ogasa. Pp. 25–30. 20 sen. Vol. 4, No. 4: Azotobacter in the Soil of Manchuria (Report 1). By Hsien Wu Cheng. Pp. 31–60. 40 sen. (Hsinching: Institute of Scientific Research.) [106

U.S. Department of the Interior: Office of Education. Pamphlet No. 88: One Dollar or Less; Inexpensive Books for School Libraries. By Edith A. Lathrop. Pp. iii+16. (Washington, D.C.: Government Printing Office.) 5 cents. [106

Proceedings of the United States National Museum. Vol. 88, No. 3081: Notes on some Pedunculate Barnacles from the North Pacific. By Dora Priaulx Henry. Pp. 225–236. (Washington, D.C.: Government Printing Office.) [116

Annals of the Royal Botanic Garden, Calcutta. Vol. 14: An Account of the Genus Dioscorea in the East. Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. Pp. viii+211–528+xx+plates 86–150. (Alipore: Bengal Government Press.) 67 rupees; £5. [116

Cornell University: Agricultural Experiment Station. Bulletin 723: Wax Emulsions for Vegetables. By Hans Platenius. Pp. 44. Bulletin 724: Farm Refrigerated Storages. By Earl L. Arnold. Pp. 40. Bulletin 725: The Value of Corn Gluten Meal for Feeding Poultry. By R. C. Ringrose, L. C. Norris and G. F. Heuser. Pp. 18. Bulletin 726: Results of Farm-Mortgage Financing in Eleven Counties in New York State. By Stanley W. Warren. Pp. 20. Bulletin 727: An Economic Study of Land Utilization in Yates County, New York. By M. D. Woodin. Pp. 52. Memoir 227: The Effect of Sulfur Dioxide on the Nutritive Value of Alfalfa Hay. By J. K. Loosli, B. L. Richards, Jr., L. A. Maynard and L. M. Massey. Pp. 40. Memoir 228: The Calcium Content of the Foliage of Forest Trees. By Robert F. Chandler, Jr. Pp. 16. (Ithaca, N.Y.: Cornell University.) [146

U.S. Department of the Interior: Office of Education. Pamphlet No. 92: Are the One-Teacher Schools Passing? 18 Years of History. By W. H. Gaumnitz. Pp. iii+17. (Washington, D.C.: Government Printing Office.) 5 cents. [146

Proceedings of the American Philosophical Society. Vol. 82, No. 1: Symposium on the Totalitarian State from the Standpoints of History, Political Science, Economics and Sociology, November 17, 1939. Pp. 102. (Philadelphia: American Philosophical Society.) 75 cents. [146

Bulletin of the American Museum of Natural History. Vol. 77, Art. 1: Herpetological Results of the Verney Angola Expedition, with Notes on African Reptiles in Other Collections. Part 1: Snakes, including an Arrangement of African Colubridæ. By C. M. Bogart. Pp. 108+1 plate. (New York: American Museum of Natural History.) [176

Canada: Department of Mines and Resources: Bureau of Mines, Investigations in Ore Dressing and Metallurgy, July to December 1938. Pp. iv+132. (Ottawa: King's Printer.) 50 cents. [176

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, JULY 20, 1940 No. 3690

FRENCH MEN OF SCIENCE IN BRITAIN

THREE weeks ago, we expressed the hope that some French scientific workers would succeed in reaching Great Britain. This hope has been realized and we are already in touch with some of them. At the time of the capitulation of their country, some were already in Great Britain ; some left southern France just in time ; others escaped, in more or less dramatic circumstances, from that part of their unhappy country now occupied by the enemy. At present, they are not a large body, but they hope, and we hope with them, that they may be joined by others who may follow in the future.

These French scientific workers have not come to Great Britain to seek refuge. They have come because they felt it was a duty to keep their place in the fight—in the fight that Great Britain is now facing alone ; they came because they still felt themselves tied to Great Britain by the solemn oath of France. They have been faithful both to their own ideals and to Great Britain. They have brought not only their readiness and their skill, but also information which will be of much service in Britain's war effort. General de Gaulle understood immediately the importance of this fact, and M. Labarthe has been appointed to take charge of the "Armaments and Scientific Research" Department of the French National Committee. So far as scientific research is concerned, the role of M. Labarthe's department will be to put the French men of science into touch with appropriate English laboratories, in order to ensure the best utilization of their skill in whatever branch of scientific or industrial research they are specially competent.

It is obvious that these French men of science cannot be allowed to enter laboratories where certain war research is going on, and we are sure that they themselves appreciate this fact. We hope, nevertheless, that they will not be prevented from joining the British war effort just because they are not British. They should certainly not be treated as enemy aliens ; indeed, the Government's offer of a month ago of complete union with France might be renewed in their case, and they might be allowed to obtain British nationality. at least for the duration of the War.

Some of the French men of science have special knowledge in branches which have no direct connexion with the war effort. They should find in the universities of Great Britain a friendly welcome, and the opportunity of continuing their researches in that atmosphere of freedom which is so necessary for creative scientific work.

Those who worked in France on war research are anxious to resume their labours in Great Britain. But they are fully aware that there may be little opportunity for long-distance research : they are ready to do any work in which they can be useful, even if it is in the nature of industrial routine ; and are prepared to take part in active defence measures in case of emergency.

The French scientific workers who have succeeded in reaching Great Britain are eager to help us in our war effort, and we must in our turn help them in every possible way. In the muddle and turmoil of the moral and military collapse of France, they have put aside all family and other ties, and have left their country in order to carry on the struggle for the ideals of democracy in which they believe. It would be but a small return for us to set them to work as soon as possible, so that they may be spared the anxious thoughts which must inevitably occupy their inactivity.

A PSYCHOLOGICAL 'HINGE' IN NATIONAL DEFENCE

JUST as German strategy concentrated on a weak hinge in the military defences of France, so in its general technique of invasion the German Command thrusts at what may be called a psychological hinge in the national defences : the weak point where military discipline ends and civil organization begins. Invasion by parachute troops co-operating with secret agents is the most dramatic form of the attack on this weak hinge. Its success in the neutral countries depended on military operations being carried out in an area which was still organized for civil life and looking to civil authority for direction. Military attack at that point in the national structure caused panic and confusion.

In Great Britain we hope that forewarned is forearmed. The question is, against what exactly have we been forewarned ? Against parachute invaders aided by secret agents ? But quite different tactics might be employed and yet fulfil the same military purpose through having the same fundamental effect psychologically.

This effect can perhaps be best described as a form of bewilderment. It results from the sudden shattering of deep-seated assumptions and expectations which the civilian—and possibly the soldier too—harbours about warfare. These assumptions are partly expressed in the formulated laws and usages of war. But the most important, psychologically, spring from less definite factors, such as custom, long-sanctioned sentiment, tradition ; or, in more modish guise, from the prevailing 'cultural patterns'. The German policy is to disrupt those patterns, and to take advantage of the resulting bewilderment.

One of our clearest cultural patterns—so long established as to seem 'natural'—is that of a strict differentiation of the military function within the community, with a specialized sub-group to perform it. Without this pattern there would be no foundation for the laws governing the treatment of non-combatants in warfare. This pattern has persisted up to the present time. Bombing from the air, it is true, brings civilians within range of military dangers and does something to blur the distinction between soldiers and others. Yet in its psychological effects the bombing we have experienced in Britain has been in some ways more like a natural calamity. It has been an ordeal in which the civilian has remained comparatively inert, passively enduring.

The psychological effect seems to be very different when the enemy's parachute troops are actually among civilians, carrying out a military attack against communications and transport in areas where ordinary civil life is the rule. If, in addition, low-flying aircraft deliberately machine-gun civilians in order to cause confusion, the sense of a personal attack is enhanced. Such attacks represent a much more intimate infiltration of military purposes into civilian life than aerial bombing has done in the past. The enemy is using his attack on civilians for a direct and immediate military purpose, that of hampering the army's operations by means of civil confusion.

Yet the civilians remain civilians. They have no training, no equipment, and no organization for resisting, and—what may be worse—they have no clear right even to resist by armed force.

The blurring of established social patterns is carried further in the use made by Germany of secret agents. The so-called 'Fifth Column' in the invaded countries has engaged not merely in espionage and sabotage, but also in actual military co-operation with enemy troops. Against these agents, presumably, even civilians would be entitled to use any force that they could. This seems to be implied in the official leaflet "If the Invader Comes", when it instructs factories to organize their own system of defence against sudden attack :

> "If you are in charge of a factory, store or other works, organise its defence at once. If you are a worker, make sure that you understand the system of defence that has been organised and know what part you have to play in it. Remember always that parachutists and fifth column men are powerless against any organised resistance. They can only succeed if they can create disorganisation. Make certain that no suspicious strangers enter your premises."

Examined carefully, the official wording here (and throughout the leaflet) can be seen to avoid giving sanction to armed action by civilians against parachute troops. The caution and vagueness of official pronouncement reflect the central difficulty : that of securing safety while still adhering to the usage of war in totally novel circumstances.

The Local Defence Volunteers represent the main attempt in Great Britain to meet this difficulty. They form the answer to a ruse which takes advantage of laws and customs that grew up in totally different circumstances from those created by the German strategem. The ban on the *franc-tireur* was based on the experience of armies of occupation which were in full military control of enemy territory. What were not envisaged were acts of brigandage by small bands of troops within territory the ordinary military defences of which are still intact. The enlistment of Local Defence Volunteers succeeds in maintaining the clear difference in military law between the soldier and the civilian, but it leavens the civilian population with men equipped for military functions and entitled to exercise military rights.

The fundamental answer to the German policy, however, has not yet been discovered. Full defence against the policy of social confusion can consist in nothing less than restoring psychological clarity to the situation. The secret agent was effective in countries where his own clear-cut intentions contrasted with the divided sympathies and faltering policy of those around him. In the Netherlands, it is reported, the 'Fifth Column' organizations were perfectly well known but were not proceeded against for fear of provoking Germany. In Britain, on the other hand, clarity of national intention should now be more easily achievable. Given that, police action, with the co-operation of the public, can handle the danger of the secret agent.

Against parachute invaders the precautions must in the main be military. Yet here the importance of the psychological 'hinge' can too easily be under-estimated and neglected. A civilian population untempered by military training and yet exposed to military attack presents a problem which has not yet been fully solved. The German politico-military Command has deliberately disrupted the older social patterns. Diplomatic pressure, military assault, brigandage, espionage, treachery, revolution, these are all familiar. But in the past they have been clearly distinguishable from each other. Now, however, the separate patterns have been dissolved and the new situation is a bewildering social hybrid. It remains bewildering so long as we try to grasp it in terms of the older patterns. In particular, the complete gulf between the civilians and the armed forces is an anachronism.

Up to the present, the policy of the army has been to work in the greatest possible isolation from civilian life. The civilian has been encouraged to cultivate total ignorance of the meaning of any military activity that cannot be entirely concealed from him. It should scarcely need technical psychology to make it clear that this policy will *not* prevent gossiping, rumour-mongering, and the spread of all manner of alarms and forebodings. Again, the policy towards civilians in a battle area has been the negative one of either evacuating them or of keeping them immobile and inert. But when battle areas are no longer neatly delimited, and new tactics make civilian panic much more likely, this policy is not certain of success. Moreover, it ignores the fact that the army may require much more positive co-operation from civilians.

The new circumstances make it dangerous for the army to persist in regarding civilians as nothing but an unavoidable nuisance. It would seem that the weak hinge between civil life and military organization must be strengthened. Much could certainly be done by the military authorities, without any leakage of vital information, to give the impression of taking the public into their confidence far more than they do at present. The leaflet "If the Invader Comes" makes it clear that the co-operation of the civilian public may be needed by the army authorities. Any more detailed expansion of the bare hints dropped by that leaflet would do something towards strengthening the weak hinge.

Many methods could undoubtedly be found of implementing such a policy if it were accepted in principle. There would be value even in so obvious a device as lectures to civilian audiences dealing in a general and non-committal way with the strategy and tactics which we may at any moment find ourselves involved in. Broadcasts have done a very little in this direction. In some ways, lectures given by military men in the actual presence of small civilian audiences would be more useful. They could have more local relevance. They would give more visible reality to the contact between civilians and military authorities.

The fact is that at present, to a great proportion of the civil population, a military officer on duty is psychologically foreign. This was of little account when wars were fought on a front line. In the new circumstances of war it is more serious. It represents a danger which can probably be met only by giving the civilian population a more visible, more local, and more definite role in their support of those who carry out the specialized military function.

SCIENCE IN ITS INFANCY

Science and the Classics
By Sir D'Arcy W. Thompson. (St. Andrews University Publications, No. 44.) Pp. viii + 264. (London: Oxford University Press, 1940.) 5s. net.

THIS dainty little book, elegantly produced by the Oxford University Press, does not pretend to be a history of science in classical times. Sir D'Arcy Thompson did not but collect in it twelve lectures delivered by him on different occasions from 1910 until 1935 (a distinguished jubilee), and connected with various aspects of science, as it was conceived and understood in this remote period, when the foundations of science were laid.

Sir D'Arcy Thompson, after winning a well-earned holiday from a laborious and long scientific and scholarly life, remembered the Greek motto which he quotes:

ἅ δ' ἄν μάθη τις ταῦτα, σῴζεσθαι φιλεῖ πρὸς γῆρας

and which he interprets in his own felicitous manner, by saying:

> "Science and the Classics! The one says (in Wisdom's words): They that eat of me shall yet be hungry. And the other says: They that drink of me shall yet be thirsty. And both alike continually enlarge our curiosity, and multiply our inlets to happiness."

Nevertheless, this book, composed in a restrained scope and scattered form, by a man to whom I should like to apply the Sophoclean verse:

φῦναι τὸν ἄνδρα πάν' ἐπιστήμης πλέων ·
(The man being full of knowledge)

constitutes a valuable contribution to the theme.

We are accustomed to look to classisism and its productions, not so much for scientific speculations and achievements, as for the highest pleasure of intellect, triumphs in expression of the human mind, or the enjoyment of impeccable forms, all attained sometimes, but never surpassed, by moderns.

Sir D'Arcy, however, teaches us that many of the classics we love and admire were interested in purely scientific speculations. As he puts it admirably: "It has been the rule from time immemorial, not the exception, for science and the humanities to go hand in hand. Aristotle the naturalist wrote of poetry; Plato was a lover of astronomy; Theophrastus the botanist was a master of rhetoric, whom even Cicero admired; Celsus the physician was an encyclopædic scholar after the taste and fashion of his age. When the humanistic tradition was at its height in the 'revival of learning', Galen and Hippocrates were read by all". May I add that Ptolemæus, the great man of science of the second century A.D., who founded the Ptolemaic system and was a writer on astronomy, chronology, geography, and music, in the elation for his work as an astronomer, composed the well-known epigram in which he compares himself, for exultation and pleasure, to a god—no less than Jupiter. This epigram, which I expected in vain to find quoted in Sir D'Arcy's chapter entitled, "Astronomy and the Classics", runs as follows in the translation of F. L. Lucas:

> "I know well I am mortal, a feeble thing and fleeting;
> Yet when I watch the wheelings of myriad star on star,
> My feet touch earth no longer. It is as I were eating,
> At the high God's own table, of Heaven's ambrosia."

Sir D'Arcy, following the examples he mentions, combines the status of a distinguished naturalist with that of a prominent classical scholar, and it is to this happy combination to which we owe first his great work, "The Glossary of Greek Birds", and now the present little volume of "Analecta", a fruitful wandering among the flower-beds of classical gardens and the more austere alleys of scientific speculations.

The chapter, "Aristotle the Naturalist", he compiled with a special interest, as this great Greek, being a philosopher and a writer on the most various of subjects, also distinguished himself as a naturalist, and thus it may be said that Sir D'Arcy has in some ways claims analogous to those of Aristotle.

I find in this chapter, with an understandable pleasure, the confirmation of what I tried to explain in regard to the description of Nature in Greek poetry, when reviewing lately, in these columns, Dr. Soutar's book (NATURE, April 27). It is so much more strikingly expressed by Schiller, whom Sir D'Arcy quotes, that I cannot but yield to the temptation of transcribing herewith the passage:

> "As Schiller puts it, the Greeks looked on Nature with their minds more than with their hearts, nor ever clung to her with outspoken admiration and affection; and Humboldt, ascerting (as I would do) that the portrayal of

> Nature for her own sake and in all her manifold diversity was foreign to the Greek idea, declares that the landscape is always the mere background of their picture, while their foreground is filled with the affairs and actions and thoughts of men. But all the while, as in some old Italian picture—of Domenichino or Albani or Leonardo himself—the subordinated background is delicately traced and exquisitely beautiful; and sometimes we come to value it in the end more than all the rest of the composition."

Sir D'Arcy has a system of his own, which he seems to recommend to others—although those who may follow his example must have the extent of his interest in reading and taste for choice. He takes note-books, he labels them according to a specified subject, and fills them with quotations, remarks and thoughts. To one of these note-books we owe the charming chapter under the title: "Games and Playthings". Sports and toys seem to have but a remote relation with science. Nevertheless, games have their science, and toys, even in those times to which Sir D'Arcy refers, have sometimes a scientific character. Playthings in the nursery of the classical period may have some similarity to those used by children of the present age. The *Krotalos* is merely our rattle. *Nymphæ*, *Koræ* and *Plangones* are simply the dolls of our girls. There is, too, the *Platagonion*, but this is not a toy. It is a custom, combined with a superstition, which curiously enough is still preserved in modern Greece. The word designates the broad leaf of the poppy, and ancient Greeks used to lay it on the palm of their hands and strike it smartly on the foreheads; it was a good omen if it burst with a loud crack. The *Roptron* is our tambourine—and so on. But we do not possess any toy similar to the extraordinary *psiphoperimombitria*. The actual game for the children was to pronounce the polysyllabic word rather than to play the toy.

The most scientific and fascinating chapter in the book is the lecture the author gave in the year 1921 at the University of Brussels in an elegantly perfect French, which would do credit to any French stylist. He developed in it the theory of *logarithmic spiral*, so strikingly demonstrated in the construction of the shell of the nautilus and other shell-fish as well as in the marvellous spider's cobweb, one of the wonders of Nature, for its unfailing geometrical perfection and unsurpassed delicacy of its thread. It is of the surmised logarithmic spiral that Pythagoras was thinking when he proclaimed the axiom: θεὸς αἰεὶ γεωμειρεῖ which Sir D'Arcy renders into French as: "Le bon Dieu fait toujours de la géometrie". But is the magnificent Greek phrase translatable?

The lectures contained in the volume do not deal with mechanics in classical times. If not a classical, but a mythological legend, that of Icarus made me always guess dreamily of it. Is the single flight of the handsome youth and his fatal fall a mere poetical phantasy or does it correspond to some reality, from which the legend spurted? Or by what mechanical means exactly the enormous blocks of marble from the Pentelicum were transported to the steep hill of the Acropolis for building there the immortal temples still standing erect, though cruelly injured by time, weather and barbarians? I wonder if there will be ever a definite answer to such queries.

Specialists or mathematically minded readers will read with pleasure and profit the two chapters: "Plato's Theory of the Planets" and "Excess and Defect: or the little more and the little less". Moreover, the volume itself will find a choice place, for consultation and relaxation, on the appropriate shelf of the library of the lover of classics.

Demetrius Caclamanos.

ELECTRICAL ENGINEERING MATHEMATICS

Mathematics Applied to Electrical Engineering
By A. G. Warren. (Monographs on Electrical Engineering, Vol. 9.) Pp. xv+384. (London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

An editorial preface by Mr. H. P. Young, an appreciative foreword by Dr. Alexander Russell, the usual author's preface, four chapters of elementary 'pure' mathematics (complex numbers and calculus), a concise statement of the mathematical relationships of electricity and magnetism in a single comprehensive chapter, and the book may be considered to be about to commence. In Chapters vi and vii we have many diverse 'applications'. But in Chapters viii and ix we have more 'pure' mathematics—more advanced (partial differential) equations and more advanced methods of integration—in fact, with the exception of a few examples in Chapter x, the whole of Chapters viii–xii can be described as pure mathematics. But in Chapters xiii and xiv we have some real practical problems.

Back to pure mathematics—still more advanced—in Chapters xv, xvi and xvii, and finally some special problems for the remaining four chapters; thus, electromagnetic waves in space and along wires, Fourier's series and harmonic analysis, Heaviside's operational calculus, and conjugate functions.

"A text-book of mathematics with some examples in the field of the electrical (mainly communications) engineer" would perhaps be a more descriptive title. The reviewer is not a mathematician and certainly not qualified to review a mathematics text-book; but as a communications engineer he can say that in this book he has found all the mathematics that he has ever had to use and much that he has always wanted to be able to use. If there is any criticism to be made, it is that there should be a greater subordination of the mathematics to the physics of the problem. Equations are stated as describing the phenomenon, the mathematical handle is turned, and the solution emerges. But the fundamental problem of the formulation of the mathematical expressions in connexion with the physical problem, which is necessary before the equations can be arrived at, is perhaps not given sufficient attention. This, to the mind of the reviewer, is the real 'application' of mathematics.

The average engineer has a pocket-book of formulæ, and his one problem is to choose the right formula. Is he much worse off than the engineer who has a book of equations—the appropriate one of which he must choose—but who has learned to turn the mathematical handle and get his own solution or formula? But the engineer who from a study of the physics of his problem can think in such a way that he can write down his own equations and then solve them (or get a mathematical friend to do so) is definitely of a different standing.

The book will find a prominent place on the reviewer's bookshelf, and he will expect to refer to it frequently.

ELEMENTARY GEOMETRY

Elementary Mathematics from an Advanced Standpoint

Geometry. By Felix Klein. Translated from the third German edition by E. R. Hedrick and Prof. C. A. Noble. Pp. ix + 214. (London: Macmillan and Co., Ltd., 1939.) 15*s*. net.

THIS book continues the translation of Klein's "Elementar Mathematik" which Messrs. Hedrick and Noble began with their translation of the volume on arithmetic, algebra, and analysis. The volume under review is that devoted to geometry. It cannot be claimed that the translation is perfect; some sentences are English only in the sense that English words are used, but in construction they are essentially German, and there are some eccentricities in spelling, for example, "parellelopiped". There are also some slips which may irritate the reader: for example, on p. 180 a footnote reads, "In the *Sixth Memoir on Quantities* [*sic*], already cited (p. 145)," and it appears that the reference is to Cayley's memoir on quantics which is correctly quoted on p. 134, not p. 145.

But in spite of these imperfections, the translators have done a useful piece of work in making Klein's volume available to teachers of mathematics who are unable to read the original German text. Klein's comprehensive treatment of the classical geometries and his exposition of the relationships between them have done much to clear up the muddle in which geometry was in danger of being lost, and it is very important that as many as possible should have the opportunity of studying the views of such an eminent mathematician on matters which concern every teacher of mathematics. It can be said that the translators have faithfully communicated the point of view and the general spirit of the original text.

It has often been said, of course, that Klein's definition of geometry is old-fashioned, and does not cover all that present-day mathematicians know as geometry. If this is true, one may ask whether Klein's work has not outlived its usefulness, and whether there is any justification for translating it at this date. We think that there can be no doubt about the answer: Klein's work has still great value, and every teacher of mathematics should be acquainted with it.

In what ways do Klein's ideas fall short of modern requirements? There are two respects in which geometry has outgrown the views expressed in this book. In the first place, there is more than one branch of mathematical science which is now commonly regarded as a geometry, and which cannot be regarded as the theory of invariants of a group of transformations in the sense meant by Klein. This point has been discussed in several places (see, for example, Veblen and Whitehead's Cambridge Mathematical Tract, No. 29, p. 31). But we do not think this in any way puts the book out of date. Klein's whole idea is to show teachers of mathematics the interrelations of the various geometries which their pupils will have to study in schools and during the earlier stages of their university careers, and for this purpose the point of view of the Erlanger Programm is not merely adequate, but the best. The pupil will want to extend his ideas of geometry at a later stage; but this should be left until he gets into the hands of the geometry specialist.

The other direction in which geometrical thought has developed beyond the limits of the Erlanger Programm is in the conception of the space in which the transformations are effected, even in the case when we do not go beyond projective geometry. Klein begins his survey from the study of ordinary (real) Euclidean geometry, then introduces the "improper elements"—elements at infinity, imaginary points, and so on. So he goes on until he reaches the conception of the geometries under consideration as the invariant theories of groups of transformations in his generalized space, the projective group containing the others as sub-groups. Then, in the last part of the book he considers the foundations of geometry, starting with the propositions of incidence. It is at this point that we feel that Klein would, if he were writing to-day, modify his work most extensively. By using the ideas of continuity, order, etc., he limits the space with which he is concerned until it is, effectively, the projective space in which the co-ordinates are ordinary numbers, complex if we make use of von Staudt's theory of imaginaries. But, how much of what is involved in this is really required? It is known that if a projective space is defined by means of the propositions of incidence and Pappus' theorem, we can introduce co-ordinates which are elements of a uniquely defined algebraic field, and this gives us nearly all that we want. It is true that in elementary geometry it is usually assumed that the field is of characteristic zero and is algebraically closed. The first condition is easily stated in geometrical form; with regard to the second, it would probably be enough in an elementary account to state as an additional defining condition that the field is algebraically closed, giving examples to show what this implies. We believe that Klein, who repeatedly expresses the desirability of connecting geometry with other branches of mathematics, might well have favoured this modern algebraic method of laying the foundations of geometry, and by his genius have provided the best possible exposition of it.

CROP HUSBANDRY

An Outline of British Crop Husbandry

By Dr. H. G. Sanders. Pp. viii + 348 + 6 plates. (Cambridge: At the University Press, 1939.) 15*s.* net.

THIS is a book which all agricultural students will find instructive. It is set out in a form which can be understood by everybody possessing an elementary knowledge of agriculture, and the enumeration of the reasons and advantages of the methods of procedure discussed will help the student to memorize them. The student will also find the bibliography at the end of each chapter extremely useful. The author has not merely given a list of books of reference, but also mentions papers from journals dealing with the subject. Only an author well acquainted with current literature could have covered so large a field.

Practical farmers will think that the book rather smacks of the lecture room, but they will find it interesting in that their attention is directed to the reasons underlying the various operations that they know from experience are advantageous. The chapter dealing with the choice and treatment of seed should be of interest to them, for at present insufficient attention is given to these important points.

Certain chapters of the book are rather unnecessarily long, and contain too many examples of rotations and dates of cultivation; in practice, rotations are usually broken, and dates of cultivations depend to a large extent upon uncontrollable factors. Evidence is also beginning to accumulate which at present tends to show that perhaps time and money is being wasted by over-cultivating the land.

The chapters on manuring and cleaning the ground will be useful to farmers. The general effects of the different kinds of manures are well set out, with an indication of the type of manure most suitable for the different crops. Fortunately, tables giving results of experiments are not included. The principles underlying the various operations on a fallow are explained; if these were more widely known to farmers, we should not see so many green fallows as we do.

The latter part of the book deals largely with matters about which the modern farmer has little to learn, but which are extremely useful to the agricultural student.

On the whole, it is an interesting and useful book, which will be of far more use to the student than the farmer, though all practical men would learn something from it. J. R. M.

Where is the —— Collection?

An Account of the various Natural History Collections which have come under the notice of the Compiler, Dr. Charles Davies Sherborn, between 1880 and 1939. Pp. 150. (Cambridge: At the University Press, 1940.) 3*s*. 6*d*. net.

THE difficulty of discovering the resting place of some important specimen has been encountered by most systematists, and doubtless justifies the "blue-pencilled" word which the author may or may not have hinted at in the title of this little book. Here about 1,700 entries give names of persons the fate of whose collections is briefly indicated.

Clearly it is impossible in the first instance to make such a catalogue complete; even important collections like the "Discovery" collections in the British Museum or the "Scotia" collections in the Royal Scottish Museum or any of the great Antarctic collections, and many others, are not mentioned. But it is misleading when entries are incomplete or inaccurate: "Edinburgh", "Edinburgh Mus.", "Edin. Mus. Sci. and Art", all inadequately indicate the Royal Scottish Museum, and in it are preserved Hugh Miller's collections and not "in his home at Cromarty"; the famous Dufrêsne collection was bought in Paris by the University of Edinburgh in 1819 for £3,000 and such of it as remains, including some type specimens (not "shells" only), is also in the Royal Scottish Museum; the collections of Sir Charles Lyell, rocks, minerals and fossils, are not "at Kinnordy", but in the Department of Geology of the University of Edinburgh. These and similar deficiencies can be put right in time; the chief concern is that Dr. Sherborn's vast knowledge and painstaking labour have created a foundation upon which a complete *Catalogus Thesaurorum* may be erected, and which in the meantime will be invaluable for reference.

JAMES RITCHIE.

Physiology in Health and Disease

By Prof. Carl J. Wiggers. Third edition, thoroughly revised. Pp. 1144. (London: Henry Kimpton, 1939.) 42*s*. net.

THE appearance of a third edition of one of the major American text-books of physiology will be welcomed by teachers of physiology. Extensive revision includes the addition of 1,400 new references, and it is as a guide to the recent literature that the book is likely to make its strongest appeal. In sections in which the emphasis on recent developments is most marked, the impression of a collection of stop-press news sometimes disturbs that of a well-digested presentation. In the course of the transfer from the summaries of original papers to the text, condensation has in some instances played havoc with the sense of the matter described, and a rather high measure of verbal carelessness enhances the feeling that the book does not represent quite the unhurried and matured conception of physiology for which we would have hoped from so distinguished an authority.

The illustrations are not very plentiful and many of them are not very telling. Ingenious and elaborate schematic diagrams of physiological processes and their relations abound, and will satisfy the craving for such things of the most enthusiastic examinee. Nevertheless, the book is alive and has quality, and will continue to be valued as one of the larger standard text-books by lecturers and advanced students of physiology who are concerned with those parts of the subject required for an understanding of human disease.

Earth Science

A Physiography. By Gustav L. Fletcher. Based on "New Physiography", by Albert L. Arey, Frank L. Bryant, William W. Clendenin, William T. Morrey. Pp. v+568. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1938.) 7*s*. 6*d*.

THE text of this book is based upon Arey, Bryant, Clendenin and Morrey's "New Physiography"; but the order of topics has been entirely rearranged and the subject-matter completely rewritten. As an introduction a general account of the past history of the earth is given, followed by a description of the dynamic forces that are changing the face of the earth to-day, and a study of the material composition of the earth. For the sake of familiarity the land is first surveyed, the author then proceeding to describe the earth's relations in space, the seasons, latitude, longitude, the atmosphere and associated phenomena like weather and climate. The book is rounded off with a study of the sea, special emphasis being placed on harbours. An interesting feature is the inclusion of a completion summary at the end of each chapter. This the reader is required to copy and complete; it is intended to counteract the bad practice of reading only the summaries of chapters. Each section is provided with a range of questions involving every important point raised in the text. The diagrams are clear and liberally distributed, the majority of them being illustrative of North American earth formations.

Protozoology

By Prof. Richard Roksabro Kudo. Enlarged and completely rewritten edition of a "Handbook of Protozoology". Pp. xi+689. (London: Baillière, Tindall and Cox, 1939.) 36*s*.

IN this edition the author has largely rewritten his text, and has also expanded the book to include certain subjects which were not touched upon in the earlier edition. The sections on morphology and physiology have been extended, though the latter appears to deal largely with work published before the first edition of this book was issued. Two entirely new chapters are devoted to ecology, and to variation and heredity. Although the soil is mentioned as an environment, no suggestion is given of the richness of its fauna, nor are some of the common soil species attributed to this habitat. In the taxonomic section a large number of species has been added, though it is still possible to find omissions; but perhaps this is to be expected in a work of this size. More than one hundred new illustrations have been included, and an adequate bibliography is supplied to each chapter.

AN AZTEC HERBAL

By DR. AGNES ARBER

OUR fragmentary knowledge of the early history of botany in Mexico has lately received a remarkable addition in the form of a reproduction of a manuscript herbal of the sixteenth century, written by an Aztec physician, and now edited by Dr. Emily Walcott Emmart[1]. It had long been known that, by the period of the Spanish conquest, gardening and medicinal botany in Mexico had reached a high degree of elaboration[2]. The fact that the language of the Nahuas included several different names for different types of garden, shows that horticulture played a considerable part in their lives. Montezuma possessed gardens for flowers and medicinal herbs, in which, according to the chronicler, Cervantes de Salazar, he "did not allow any vegetables or fruit to be grown, saying that it was not kingly to cultivate plants for utility or profit in his pleasance". He also owned vegetable gardens and orchards, but these he seldom visited, since he held them to be "for slaves or merchants". His contempt for mere utility did not extend, however, to curative herbs. He ordered his physicians to make experiments with the medicinal plants in his gardens, and to use the best-tried remedies for the benefit of the lords of his court.

Montezuma the Elder, in the fifteenth century, restored an ancestral tropical garden at Huaxtepec. It is recorded that he sent to the Lord of Cuetlaxtla for plants with roots of the vanilla orchid, cacao, magnolia, and other exotics, and asked that they should be escorted by native gardeners capable of cultivating them. His directions were followed religiously, and the plants arrived with their roots in earth and wrapped in beautifully woven mantles. The gardeners, before replanting these treasures, fasted for eight days, and made sacrifices of incense and other offerings before the god of flowers. This procedure was a great success: the plants flourished exceedingly, and Montezuma wept with joy at the triumphant result of the experiment. Dr. Zelia Nuttall, in whose work a fuller account of these matters will be found, writes that nothing now remains of this—the first tropical botanic garden of the American continent—except a few immemorial cypresses.

In 1570 a certain Francisco Hernández was sent to Mexico by Philip II to investigate the natural history of New Spain; he was the first European botanist to study the vegetation of the New World. He spent seven years in Mexico, passing much of his time in the garden of Huaxtepec. It was not until the middle of the seventeenth century, however, that his great work upon the plants of Mexico saw the light; but at an earlier date (1615) Francisco Ximenez issued a partial Spanish translation of it, which has the distinction of being the first published book treating of the herbal remedies of the Aztecs. It has now, however, yielded pride of place, as the first record of the subject, to a small Latin manuscript, bound in crimson velvet of the sixteenth century, discovered in 1929 by Prof. Charles U. Clark in the Vatican Library; this work proved to be an Aztec herbal in Latin, with pictures. In the same year an Italian translation of the Vatican manuscript was found in the Royal Library at Windsor. The Vatican copy has been studied in extreme detail by Dr. Emmart, who, with the aid of a number of public and private benefactors, has been able to publish a coloured and copiously annotated facsimile of the herbal. The whole work is on a sumptuous scale, though the price has been kept intentionally to a low level, in order to bring it within the reach of students.

Soon after the Spaniards had conquered Mexico, schools for the Indians were built with funds provided by the treasury of Charles V. In the Convent of San Francisco in Mexico City, native boys were taught reading, writing, music, and other subjects. These pupils were found to be so teachable that a further step was taken in 1536, when the College of Santa Cruz was established at the Convent of Santiago on the outskirts of the same city. Here the students learned Latin, philosophy, logic, arithmetic, and music. Moreover, the Spaniards realized so fully the importance of the indigenous pharmacopœia, that they brought to the College the best known of the Indian physicians, so that they might hand on the knowledge of native herbs. It was one of these teachers, Martinus de la Cruz, who compiled the recently discovered herbal; its translation into Latin was due to Juannes Badianus, an Indian who was "Reader of Latin" in the College. The manuscript is modestly described on the fly-leaf as "A little book of Indian medicinal herbs, composed by a certain Indian, physician of the College of Santa Cruz, who has no theoretical learning, but is thoroughly instructed by experience alone. In the year of Our Lord Saviour 1552". The work was undertaken as a gift for Charles V, at the request of Don Francisco de Mendoza, to whom it was dedicated. Its intention was primarily medical;

the plants are grouped under the diseases which they are reputed to cure.

Pliny's "Natural History" was one of the Latin texts used by the students of the College, and the latinity of Badianus is said to show signs of Pliny's influence. Since, however, the plants are not those of Europe, they are kept under their Aztec names, which are spelt phonetically and not latinized. Apart from its interest for the history of medicine, the most striking feature of the book is the beauty of the illustrations, which approach two hundred in number. Dr. Emmart concludes that they were probably the handiwork of Martinus rather than of Badianus, but they show so much accomplishment that it may perhaps be suggested that they were executed neither by Badianus, the classical lecturer, nor by Martinus, the physician, but by some professional artist whose name has not come down to us. The peculiarly rich colour of these pictures contrasts happily with the warm tint of the paper, the crimson lettering used for the plant names, and the reddish-orange marginal lines, which enclose the pages. Mexico in early days was famous for its brilliant native dyes, and Cortez wrote that paints of good quality could be bought in the market-place of Tlaltelolco.

To those accustomed to European botanical illustrations, the way in which the roots are portrayed is the most unfamiliar feature of the figures in the Badianus herbal. The technique is difficult to describe in words ; but it may be said in general that the root system is indicated in a conventional fashion on a patch of background varying in colour and form. Sometimes the Aztec stone- or water-symbol can be detected. Dr. Emmart claims that in the treatment of the roots, "there is an attempt to represent the ecology of the plant pictorially—a direct carrying over of Aztec pictographic representation". A comparison of the roots throughout the herbal offers—at least to the uninitiated—no very obvious confirmation of this view ; if such symbolism was intended, it is, except in special cases, curiously variable and obscure. It is perhaps possible that an explanation of a slightly different and more prosaic type may be worth considering. In Mexico "chinampas", sometimes erroneously called "floating gardens", have been used from antiquity and may still be seen to-day (Nuttall). They are raised mud beds, artificially built up in lakes or lagoons, staked off with cane, and bordered by pruned willows, the interlacing roots of which are trained to form a sort of basket-work which holds the banks. A special method is used for the transplantation of young annuals from mud beds in which the seedlings have been set out. The substratum is cut up deftly into solid blocks, and each plant is lifted with a compact mass of soil enclosing its roots. If the Aztec artist who illustrated the Badianus herbal was accustomed to this mode of handling plants, it might seem natural to him to represent roots in association with a block of the substratum. It is noticeable that, when very small plants of a mossy or turf-like habit are depicted, the individual plant with its roots is not isolated, but a whole group is shown, growing on what is apparently a block of soil. Later research may perhaps prove that the colouring and decoration of these blocks and balls of soil had a well-defined symbolic meaning, but, judging merely from appearances, it looks as if the artist had just enjoyed himself in giving free rein to his painter's fancy.

As representations, the illustrations of the Badianus herbal are of very unequal merit : among the best are those of an aroid (Xanthosoma); two species of Datura ; a species of Commelina ; and two cacti (Opuntia and Cereus). A great many of the pictures are, however, quite unrecognizable, and bring to mind European herbal illustrations in the degraded condition which they reached after a process of copying from manuscript to manuscript which extended over centuries. Indeed, in looking through the Badianus herbal, one cannot but be struck by the fact that both the realistic and the more conventionalized examples show a decided resemblance to Old World herbal drawings of the period before printing. The general style often so closely recalls that of European plant pictures, that it is difficult to believe that the Mexican figures owe nothing to the stream of artistic tradition which can be traced back to Greek botanical illustration dating from before the beginning of the Christian era.

The American scholars concerned with the Badianus herbal take, however, a somewhat different view. Dr. Sigerist, who writes the foreword, says that the manuscript is "a purely Mexican product", and that "as far as we can see, it shows no traces of European influence". Dr. Emmart also takes the view that "whether the authors of the manuscript ever saw and studied an illustrated European herbal, is a question of considerable doubt", and she regards the technical skill of the Aztec illustrator as "indigenous to the soil of Mexico and not obtained by contact with European culture". No one would, of course, wish to deny that these illustrations are, to a great extent, the outcome of a long tradition of Mexican art ; we know, for example, that Nezahualcoyotl, the fifteenth-century king of Texcoco in the valley of Mexico, had pictures of tropical plants painted from Nature and copied on to the walls of his palace. Nevertheless, we may be allowed to feel that the native tradition was to some extent overlaid, in the Badianus herbal, by European influences ; otherwise we have to postulate a degree of parallelism exceeding probability, between the highly stylized and sophisticated schools of herbal illustration of the Old and the New Worlds.

It should be remembered that the Indians were highly susceptible to the education offered to them by the Spaniards; in the year 1541, Gerónimo López wrote that some of the Indian boys "speak Latin as elegantly as Cicero". We are told, also, that in the Convent of San Francisco, those native boys who showed ability in drawing and writing, were given the task of illuminating manuscripts; here influences from Europe had a direct opportunity of playing upon Aztec art. The staff of the College of Santa Cruz must have consisted of men of broad culture, and they cannot have carried on their work without books. Even though they were sojourning in a country with an unfamiliar flora, it is unlikely that illustrated herbals found no place in their library, considering the importance then attached to these books from a medical point of view. We may at least conclude that the possibility of European influences having had their role in determining the style of the pictures in the Badianus herbal, cannot at present be rejected. It is to be hoped that the later work of American students of the Aztec civilization may reveal more decisive evidence on this point.

The Badianus herbal contains an important body of directions for the treatment of ill-health, not only by pharmaceutical, but sometimes also by surgical methods. Occasionally there are indications of a surprisingly enlightened attitude. For example, both melancholia and fatigue are recognized as conditions for which medical treatment is suitable. The needs of the ancient Aztecs are indeed ours to-day, for we read of certain medicaments intended to relieve the "fatigue of those administering the government and holding public office", and also serving to "drive weariness far away, and, finally, to expel fear, and fortify the heart of man".

---

[1] The Badianus Manuscript (Codex Barberini, Latin 241), Vatican Library. An Aztec Herbal of 1552. Introduction, translation and annotations by E. W. Emmart. (Johns Hopkins Press, Baltimore, 1940.) 7.50 dollars.

[2] The Gardens of Ancient Mexico. By Z. Nuttall. (Ann. Rep. Smithsonian Inst., 1925 for 1923, pp. 453–64.)

TREATMENT OF HOUSEHOLD REFUSE

By W. Carmichael,
Lighting and Cleansing Department, Edinburgh

THE first question asked by a local authority before embarking upon expenditure in connexion with an intensified salvage campaign is: How much salvage should we extract from our refuse? This is followed by the query as to the value of the expected salvage, and then: What is the position of the markets for the materials so extracted?

The second question is most easily answered by local rather than national inquiry, but the first question may be partly answered by the experience of other towns, although it is not possible to lay down a hard-and-fast table of quantities per ton of refuse which may be expected throughout the whole of Great Britain. The average percentages of the seasonal analyses of household refuse conducted under the ægis of the Ministry of Health, prior to the War, offer a guide; but, as the War has had an effect on normal ways of living, it is prudent to expect this effect to become noticeable in the constituents of the household refuse. Accordingly, the pre-War analyses only comprise a stop-gap until local authorities can institute analyses of their own. The results already achieved by many towns may appear very gratifying from a cash or gross tonnage point of view; but actual analyses of refuse should be carried out in order to be sure that the full salvage value is being realized.

Few towns are achieving the expected percentage of waste paper expected, namely, one ton per 1,000 of the population per month, or, expressed approximately in terms of refuse, 4 per cent of paper of the total tonnage of refuse handled. Despite the curtailment in the output of paper, this percentage of paper at least is, I am certain, available in every town in Great Britain. In making this statement, I am not taking Edinburgh's high figure for waste paper and making it applicable to all. For the week ending June 8, the percentage of waste paper to total household refuse collected in Edinburgh was 10 per cent. For the month of May, the total sales of waste paper collected by Edinburgh Cleansing Department amounted to 682 tons 6 cwt., with a revenue of £2,809; this tonnage represented 8·6 per cent of the total household refuse collected during the month. The high percentage of paper to refuse in the week ending June 8 was due to a sudden spell of hot weather which caused a drop in the ash element of the refuse. These figures show that a collection of one ton of waste paper per thousand of the population per month is quite possible. The annual recovery of waste paper throughout Great Britain at this rate would represent more than half a million tons. This would be fully one hundred per cent increase on the present rate of collection, and, moreover, sufficient to satisfy the needs of the paper- and board-making industry.

There should be no need to emphasize that the collection of waste paper will prove economical to the collecting authority. A glance at Paper Control Order No. 15 will convince. Present prices for waste paper, loose and baled, are :

	Loose	Baled in 4-ton lots
Newspapers	90*s*. per ton	127*s*. 6*d*. per ton
Strawboards ..	65*s*. per ton	105*s*. per ton.
Books and magazines	70*s*. per ton	107*s*. 6*d*. per ton
Mixed paper ..	40*s*. per ton	80*s*. per ton

In Edinburgh, the revenue from paper pays for the wages of all operatives on refuse disposal and paper collection and sorting, and leaves a surplus.

Prior to the War, Edinburgh could expect 1¼ per cent of household refuse to comprise rags. When an analysis was taken recently, we were surprised to find that the percentage of rags was equally as high as that of the pre-September period. However, it is too optimistic to look for such a figure to-day and we prefer to base our output on the Ministry of Supply's expectations, namely, 2 cwt. per thousand houses weekly. There are 120,000 households in Edinburgh, and our total of rags for the week ending June 8 was 11 tons, or just under the Ministry of Supply's expectations. Rags output per household may not be considered so constant as that of paper and its fluctuations will depend more upon economic considerations than does paper, the use of which is more temporary and output dependent on control.

Bones are expected by the Ministry of Supply on the basis of 1 cwt. of the population per month, but, obviously, this figure cannot be expected throughout the whole year. Warm weather is accompanied by a smaller consumption of butcher's meat than cold weather and, accordingly, the summer output might be put at ½–¾ cwt. per 1,000 of the population per month. At present, Edinburgh has been responsible for a little more than half the total of all bones collected in Scotland. The success achieved in the collection of this very important item of salvage has been due in no small measure to the adoption by the Edinburgh Education Committee of the scheme to collect bones through the schools. This scheme was put into force in February and bins were supplied to ninety-five schools for the reception of the bones wrapped in paper. The Medical Officer of Health gave the scheme his blessing from the start, which factor anticipated and effectively answered critics of the scheme from a health point of view.

Probably the householders' response to the appeal for salvage will be greatest in the realm of ferrous metals. Here again, however, tonnage will be a passing phase and, after a thorough comb-out of substantial items, authorities will fall back upon the humble tin can for their constant source of scrap.

Edinburgh has the credit of being one of the leading towns in Britain for salvage consistency and, accordingly, its methods of salvage may be of interest to other towns.

From the salvage point of view, the completion of Edinburgh's new disposal plant at Seafield in the month of the outbreak of war, and its commencement on September 21, came at a most fortunate time, as it meant that, thereafter, the total output of Edinburgh's household refuse would be mechanically treated in plants which offered the opportunity for maximum salvage extraction. The Seafield plant has a capacity of 140 tons per day ; Russell Road (opened in March 1938), 240 tons per day ; and Powderhall, 200 tons per day.

The efficiency of Edinburgh's disposal plants in the extraction of salvage can be illustrated by an analysis of the extraction at Russell Road for the week ending June 15 :

TOTAL REFUSE TREATED : 684 TONS 10 CWTS.

Salvage extracted	Tons	Cwt.	Percentage of refuse
Metals	44	5	6·45
Bottles (8,040) ..	3	7	0·49
Rags	10	19	1·60
Paper	45	13	6·67
Bones	—	15	0·12
Cullet	2	11	0·37
Cinders	70	—	10·20
	177	10	25·90

Thus it appears that 25 per cent of household refuse can be sold for re-use. If the experiments presently being carried out on the city's farms to test the fertilizing properties of the 50 per cent of dust now being screened from the refuse are as successful as the initial reports suggest, it may well be that, in the near future, Edinburgh will be re-selling 75 per cent of the total household refuse collected.

During the week referred to above, in addition to 84 tons of waste paper recovered at the disposal plants, 80 tons were collected by the special collection service. This service, which has been operating since before the War of 1914–18, has collected in the aggregate since that time 51,551 tons of waste paper, which have been sold for £93,126. The service has gradually increased from two horse lorries to ten. Each lorry has a specified route each day, and is entirely devoted to the collection of waste paper. Sacks are supplied to all households or business premises which will take them, and they are collected at weekly or fortnightly intervals. Some 20,000 sacks are in circulation.

The instructions given to Edinburgh householders for the preservation of their re-usable waste, so that the City's Cleansing Department may have it in its best condition, are simple. They are asked to put aside paper and rags to avoid contamination by contact with ashes, etc. Bones should be sent to the school bin ; or they can be put in the ash bin and they are then extracted from the refuse at the disposal plants. Collecting vehicles removing refuse carry sacks for the removal of paper and rags.

Recently a salvage shop was opened and, in the space of four weeks, it had attracted 100,000 visitors. In the first week, fifty requests a day were received for the special removal of accumulations of salvage; but, in the succeeding weeks, the number of requests went up to 100 per day. Hourly talks on salvage were given by loudspeakers and, in addition, there was a cinema room where a salvage film, running for ten minutes, was shown at half-hourly intervals throughout the day. This exhibition, without a doubt, has done much to make Edinburgh citizens more "salvage-conscious" than hitherto.

A FRENCH EXPEDITION TO THE CAMEROON MOUNTAINS

By RENAUD PAULIAN,
MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

IN the summer of 1939 the Muséum National d'Histoire Naturelle de Paris, the Comité de la France d'Outre Mer du Centre National de la Recherche Scientifique, and the International Institute of Volcanology, in full accord with the British Museum (Natural History), sent a scientific expedition to the volcanic mountains of the Cameroons. This expedition consisted of B. Gèze, geologist, P. Lepesme, entomologist, A. Villers, assistant taxidermist, and myself, entomologist. We were to study the biological conditions prevailing on the principal mountains of the Cameroonian range, and we visited Mt. Cameroon (4,070 m.), Mt. N'Lonako (1,800 m.), Mt. Manengouba (2,400 m.), and Mt. Bambouto (2,600 m.). From a climatic point of view, it appears that the rainfall decreases regularly from more than 10 m. a year to about 2 m. a year from the first to the last of the above-named mountains. Together with this decrease in rainfall, human settlements and cattle increase in number and importance. As a consequence, Mt. Cameroon bears a belt of rain-forest from about 1,000 m. to about 2,000 m. ; this forest belt is still extant on Mt. N'Lonako, while on both Manengouba and Bambouto the belt has been broken to pieces and the prairie of the surrounding highland plains goes right to the summit. This breaking up of the forest must be rather recent, as in the Bambouto prairie we found isolated plants of tree-ferns and Clematis, both inhabiting the surviving forest patches on the same mountains.

The phytological differences in these mountains bring about important zoological differences. On Mt. Cameroon it is possible to distinguish a number of zoological zones. Beginning at 900 m., around Buea, and ending at 1,000–1,200 m., is a transition zone between the pastures and the lower limit of the rain-forest. This zone is inhabited by quite a number of insects and other animals that do not live in the forest, or in the lowlands below 600 m. : Lacertidæ, Trechinæ, Sericinæ, etc. Above this zone, five successive biological strata may be recognized. Two of them are in the rain-forest itself. The first extends from 1,100 m. to 1,500 m., and the second reaches from 1,500 m. up to 2,200 m. The insect and wood-louse faunas are widely different in these two zones. We may recall here that Engler found two phytosociological strata in the rain-forest of Mt. Cameroon and his altitudinal data fit our zoological observations well. In fact, the change of zoological aspect is coincident with the disappearance of the tree-ferns.

From 2,200 m., upper limit of the rain-forest on the south-east, up to 2,800 m., the trees have completely disappeared and the irregular lava boulders of this very strong slope (up to 50°) are covered by a short vegetation of Gramineæ, interspersed at the base with Inula and a few ferns, and higher up with a representative of the Campanulaceæ. This slope is very dry and its fauna is practically nil. From 3,000 m. to 3,500 m. the slope is much less steep ; this part has even been called 'plateau' and is deeply cleft by gulleys full of shrubs, Clematis, Adenocarpus, etc. ; on the upper ridges the tree-heather, Agauria, grows on the lava-flows, and the grass prairie is strewn with small patches of Blearia. Owing to the frequent lava-flows and to the annual prairie-fires lit by native hunters, the fauna is very poor; oddly enough, Homoptera and Diptera with a high flight-power make up the greatest part of the fauna. Coleoptera are scarce; apart from two species of Pæderus, which appear to follow man everywhere in those parts, we found only a few Carabidæ, Chrysomelidæ, Curculionidæ and Clavicornia. We could discover neither Amphibia nor reptiles.

Above 3,500 m. nothing grows but lichens and mosses, and the fauna, except for a brachypterous crane-fly, is practically nil. Running water is very scarce on Mt. Cameroon, and the aquatic fauna is poor. I could find no plankton at 3,200 m. and, from 1,500 m. upwards, we saw neither dragonflies nor caddis-flies. This paucity of the aquatic fauna has already been noted for many volcanic lands, for example, by Aubert de la Rüe in the New Hebrides.

On Mt. N'Lonako, the rain forest rises to 1,700 m., the upper range of the mountain being covered by grass prairie. The fauna is much more important than on Mt. Cameroon, both in the forest and above it, and the aquatic fauna is well represented by Gyrinidæ, a number of dragon-fly nymphs and some aquatic Hemiptera.

On Mts. Manengouba and Bambouto, as already stated, the forest is restricted to broken up patches, completely isolated in the grass fields. The terricolous fauna is rich, with a great number of Carabidæ (Agonum, Stenaptinus, Scarites), Scarabæidæ (Distellopalpus, Heliocopris); beating the bush and sweeping grass give an ample collection of Rhynchophora and Malacodermata; the Chrysomelidæ are scarcer than in the lower forest zone on Mt. Cameroon, and the Galerucinæ are particularly rare, but the Halticinæ seem much more numerous. Owing to the breaking up of the forest many grass-field animals extend to much greater altitudes on Mt. Bambouto than on Mt. Cameroon. This is especially true for all the lizards and the toads. The aquatic fauna is quite important on these two mountains, though aquatic Hemiptera are much scarcer than on the lower table-lands of East Cameroon. On both these mountain ranges the earth layer is very thin, and on Mt. Manengouba I found huge quantities of larvæ of a Cetoniine (*Dymusia cyanea*) living under the stones, on the bare rock. Many of these larvæ appear to be drowned by the heavy rains.

From a bio-geographical point of view, it is interesting to recall that many East African species or groups of species have been found on the Cameroon mountains. Such East African affinities are much clearer in the case of the fauna of Mt. Bambouto than they are in that of the fauna of Mt. Cameroon itself. In fact it appears as if the fauna of the upper ranges (above 2,000 m.) of Mt. Cameroon had been completely destroyed by the lava-flows which built the summit of the mountains, probably (B. Gèze, *C.R. Soc. Géol. France*, 15, 219; 1939) during the Quaternary. The fauna which is to be found there now is derived from the local lowland fauna. The upper ranges of Mt. Cameroon give us a splendid natural field for the study of segregation, species formation and Cuénot's theory "des places vides", the more so as the upper alpine region is separated from the upper limit of the forest by a thousand-metre zone with a very steep slope on which animal life cannot thrive. Unhappily the frequent prairie fires prevent the normal faunal reconstruction. From the fact that the lower slopes of Mt. Cameroon, from 100 m. to 1,800 m., have a fauna with distinct East African affinities, it must be admitted that this part of the mountain is much older, as old in fact as Mts. Bambouto and Manengouba. The East African character of the fauna and flora of Mt. Cameroon, without any reference to Mts. Manengouba and Bambouto, had been pointed out already by the late G. L. Bates for the birds and by Hutchinson and Dalziel for the flowering plants.

OBITUARIES

Prof. Alfred Fowler, C.B.E., F.R.S.

PROF. ALFRED FOWLER, emeritus professor of astrophysics in the Imperial College of Science and Technology, London, and late Yarrow research professor of the Royal Society, died on June 24.

Alfred Fowler was born at Wilsden, Yorks, on March 22, 1868—the seventh consecutive son of Hiram and Eliza Fowler. The family removed to Keighley about 1876, where Alfred attended various local schools. In 1880 he obtained a scholarship for the Trade and Grammar School, Keighley, from which in 1882 he proceeded to the Normal School of Science (later Royal College of Science), South Kensington, through the aid of a Devonshire exhibition. This terminated after one year, but he continued at the College as a 'teacher in training', and in 1885, at the early age of seventeen, obtained a first class associateship in mechanics. He then became assistant to Prof. (afterwards Sir) Norman Lockyer, and received some remuneration as teacher in training, supplemented by small allowances from the Solar Physics Committee. Among his pupils were many who afterwards achieved distinction—notably

Sir Richard Gregory and Mr. H. G. Wells. In June 1888, a new post of demonstrator in astrophysics was created, and Fowler was elected to fill it.

From this time until Lockyer's retirement from the College in 1901, the two men were closely associated in researches in astronomy and spectroscopy, the full significance of which became clear only after the development of atomic theory had given an interpretation of the origin of spectra. It was then seen that the classifications of stellar and laboratory spectra made on empirical grounds at South Kensington, and in the making of which Fowler took a much more active part than was generally realized at the time, provided invaluable information on the physical conditions in the sources of luminosity, and they became the foundation of the extraordinary progress in this branch of science which has been going on for the last twenty-five years and is still one of the most prominent characteristics of both theoretical and experimental research. Spectroscopy at that time found its chief, and indeed almost its only considerable, application in astronomy, and Fowler was active in day and night astronomical observation not only at South Kensington and at Westgate-on-Sea, where Lockyer had established an observatory, but also in eclipse work in various parts of the world. During his association with Lockyer he went to the eclipses of 1893, 1896, 1898 and 1900 in West Africa, Norway, India and Spain, respectively, and later he visited Spain again in 1905, made important visual observations at the partial eclipse of 1912 at South Kensington, and set out for the eclipse of 1914 in Russia, but was forced to return on account of the outbreak of war.

In 1901, when Lockyer retired from College work and a definite separation was made between the College and the Solar Physics Observatory, Fowler was appointed as assistant professor of astrophysics, and owing to reduced astronomical equipment and the rapid development of the great American observatories, he tended more and more to concentrate on laboratory spectroscopy. His astronomical knowledge and interests, however, still exercised an important influence on his work, and with studies of the series spectra of the elements he associated such outstanding discoveries as the identification of the TiO bands in the spectra of red stars, of MgH and other bands in the spectra of sunspots, and of the CO bands in the spectra of comets' tails. His work on the spectra of hydrogen and helium at once became of fundamental importance with the advent of the Bohr theory in 1913, and from that time onwards he was a leader on the experimental side in the collaboration between theory and observation which has led to the present detailed knowledge of the outer structure of atoms. He was elected a fellow of the Royal Society in 1910, appointed professor of astrophysics in the Imperial College in 1915, and in 1923, when the Yarrow research professorships of the Royal Society were established, he was elected, with Prof. G. I. Taylor, as one of the first holders of the title. He continued to work at the Imperial College and to direct spectroscopic research there until his retirement in 1934.

Of the many services which Fowler rendered to science on the side of administration and organization, it is impossible to give an adequate account in a brief space. In addition to services on the Council and committees of the Royal Society and Royal Astronomical Society (of which he was secretary from 1912 until 1918, president from 1919 until 1921, and foreign secretary from 1931 until 1936) he was, among other things, a member of the Board of Visitors to the Royal Observatory, Greenwich, a fellow founder and president from 1935 until 1937 of the Institute of Physics, a member of the Executive Committee of the National Physical Laboratory and of the Advisory Council of the Department of Scientific and Industrial Research, and, after his retirement, a member of the governing body of the Imperial College. With Fowler, these were no mere formal offices, but responsibilities which he discharged with a thoroughness and strong commonsense which were characteristic of everything he did, and perhaps even more valuable than his overt services were those which he gave spontaneously and generously without thought of return or reward. NATURE, in particular, owes much to his labours. His association with Lockyer naturally brought him into close relation with this journal, and he was a constant contributor to "Our Astronomical Column" which for many years was a characteristic feature of NATURE. But perhaps his outstanding work in this category was done in connexion with the formation of the International Astronomical Union. He had already taken a prominent part in the working of the International Union for Co-operation in Solar Research, which came to an end with the War of 1914–18, and on the formation of the International Astronomical Union, originally as an activity of the International Research Council, he was appointed as the first general secretary, and more than any other single man was responsible for establishing the Union and for the form which it afterwards took. He remained as general secretary for six years.

In later years honours came in quick succession. He was in turn awarded the Valz Prize by the Academy of Sciences, Paris, the Gold Medal of the Royal Astronomical Society, a Royal Medal, and honorary degrees of D.Sc. (Bristol), Sc.D. (Cambridge), D.Sc. (Durham), and D.Sc. (Leeds). In 1920 he was elected *Correspondant* of the Academy of Sciences, Paris, in the Section of Astronomy, and in 1926, president of Section A of the British Association. In June 1935, he was elected a fellow of the Imperial College and created C.B.E. for services to science. American astronomers acknowledged his work by the award of the Henry Draper Gold Medal for Astrophysics, and the Bruce Gold Medal of the Astronomical Society of the Pacific, and by electing him in 1938 as a foreign associate of the National Academy of Sciences.

To those who were fortunate enough to know him, however, Fowler will be remembered chiefly for his inspiration as a teacher and his never-failing encouragement and readiness to help in every way possible. His laboratory was the training-ground for many who have since achieved distinction in various spheres, and there have been numerous acknowledgments of indebtedness to his guidance and sympathy. It was his aim always to develop and never to repress the qualities he discerned in those who came under his charge, whether or not those were qualities in which he himself excelled. He leaves a widow, a daughter and a son, by whom, and by his many friends, he will be greatly missed.

HERBERT DINGLE.

Lieut.-Commander J. R. de la H. Marett

LIEUT.-COMMANDER JOHN RANULPH DE LA HAULE MARETT, R.N., of H.M.S. *Glorious*, presumed killed in action, was, like his father, Dr. R. R. Marett, rector of Exeter College, Oxford, a student of anthropology, though he approached the subject from a somewhat different angle. Like his father, however, he had a bold pioneer spirit, and was not afraid to collect and review the specialized contributions of many others with the view of showing what came of the synthesis, and what problems were raised in the whole effort to understand man, his race, culture, and environment. Like his father again, he held that all specialized contributions, including his own, must be judged in the light of their relation to the whole complex of studies. Many famous pupils of Dr. Marett will recall this constant attention to great problems and main issues, and those who knew his son, including his former teachers, will remember in him the same flair for formulating and planning the line of approach and possible solution. To the father has been given the fullness of time to show the value of his attitude to life. To the son, this longer time has been denied, but to those who knew his work, there has been ample promise of great fulfilment and much valuable and stimulating achievement.

The younger Marett served at sea during most of the War of 1914–18, and afterwards retired from the Navy to take up farming in Jersey, an island beloved by himself and his father. His main interest as a farmer was the care of a famous herd of Jersey cattle, and as editor of *The Island Cow* he contributed articles on animal genetics that attracted a good deal of attention, more particularly in America. It was this interest in genetics that brought him to Oxford, where he studied anthropology, obtaining the diploma with distinction in all subjects. Later, after a considerable amount of work elsewhere, mainly on problems of genetics, he was awarded the B.Sc. degree at Oxford, for a thesis which afterwards developed into a substantial book, entitled "Race, Sex, and Environment, a Study of Mineral Deficiency in Human Evolution" (Hutchinson 1935). Though this essay deals mainly with man, and covers a vast field, it probably grew naturally out of his earlier work on the theory that the Jersey breed of cattle is Nature's successful attempt to cope with calcium deficiency; and the same principle when extended to man suggests various lines of investigation that may well prove to be exceedingly fruitful. While it is easy for specialists in the varied fields from which he has gathered to criticize him, it must be remembered that much of his synthesis and many of his suggestions are those of a pioneer in a great adventure. His attempt to synthesize work on the soil sciences with that on the ductless glands on so large a scale opens a vast unexplored country, a land of great promise.

During the last few years, Marett was conducting an enthnological survey of Ceylon for the Government, and it is to be hoped that his researches, which have resulted in a rich store of material, will some day be published.

Leaving this valuable work on the outbreak of the present War, he once more undertook active service, and now, to the best of our knowledge, has given his life for his country. While there can be no greater gift, his friends and former teachers cannot fail to regret that a life so full of brilliant promise could not have been given, in the happier times to come, to the constructive work which he was so able to do.

T. K. PENNIMAN.

Dr. E. G. C. Poole

EDGAR GIRARD CROKER POOLE was born in Limerick, the son of Major Walter Poole, R.A.M.C., and educated at Rugby and the Queen's College, Oxford, where he was mathematical scholar. He obtained both the Junior Mathematical (1911) and the Senior Mathematical (1920) University scholarships and two first classes in the school of mathematics. He was one of C. H. Thompson's most brilliant pupils. During the War of 1914–18 he served as a lieutenant in the Intelligence Corps in France. In 1920 he was elected fellow of New College and was for a time a University lecturer in mathematics. At the time of his death he was one of the editors of the *Quarterly Journal of Mathematics*.

Poole was the most learned of the Oxford mathematicians. He had a magnificent library and he constantly read very widely in all branches of pure mathematics. He was an excellent linguist also. His published papers were mainly on differential equations, an important work on which was published by the Clarendon Press in 1936. He was a good teacher and a good colleague. He was, however, ultra-sensitive and events unconnected with himself as, for example, the depression of 1931 and the bad news of this year made him utterly miserable. Despite his fine reputation for work both as a researcher and a teacher, he felt in recent months a keen sense of depression and frustration; this produced the ill-health which led to his death in tragic circumstances on June 28.

Oxford has thus lost a fine and most erudite mathematician, and his college a delightful colleague and friend. He was forty-nine years of age.

WE regret to announce the following deaths:

Sir Alfred Bourne, K.C.I.E., F.R.S., formerly professor of biology in the Presidency College, Madras, on July 14, aged eighty.

Dr. W. E. Harper, director of the Dominion Astrophysical Observatory at Victoria, B.C., on June 4, aged sixty-two.

NEWS AND VIEWS

Organization of French Scientific Services in Britain

DR. ANDRÉ LABARTHE, as already announced, has been appointed by General de Gaulle to take charge of technical armament services and scientific research for the French National Committee. M. Labarthe, who was born in 1902, was a pupil of the late Prof. Gabriel Koenigs, and specialized in experimental mechanics. After a year in the physical research laboratories of the Ministry for Air, he went to the laboratory for physical and experimental mechanics at the Faculty of Sciences, Paris, where he became *assistant* (1931), and then *chargé de conférences* (1934). His thesis for his D.Sc. dealt with photo-electric methods of measuring pressure, the measurement of torsion, and integrating manometers. In addition, he has studied ultra-rapid cinematography, detonation, and internal combustion engines, particularly Diesel engines. M. Labarthe was the head of a delegation sent to Germany in 1934 to study the Diesel engine, and he has also visited England and the United States to inspect scientific and industrial laboratories. In France he has been technical director in the Department of Aeronautics, and recently director of the Station Nationale de Recherches d'Expériences technique and director of the laboratories at Bellevue. He has received the Plumey Prize of the Paris Academy.

On the outbreak of the War, M. Labarthe put his valuable knowledge of armaments in general, and of internal combustion engines in particular, at the disposal of the French Government, and he was recently technical director and adviser to the Ministry of Public Works. Not only did he succeed in leaving France after the general collapse, but also he managed to bring with him to Great Britain a ship carrying a valuable cargo of copper. In addition to his purely scientific publications, M. Labarthe is the author of "La France devant la guerre," a remarkable study of the 'war potential' of the belligerent nations. That book finishes with a quotation from Lacordaire which to-day has new significance: "Tant qu'un peu de sang français subsistera, la Justice aura sur terre un soldat armé".

War-time Livestock Problems: Advisory Committee

A COMMITTEE to consider war-time livestock production problems has been set up by the Minister of Agriculture. The members of the Committee are: The Right Honourable Lord Moyne, Joint Parliamentary Secretary to the Minister of Agriculture; Prof. A. W. Ashby, professor of agricultural economics, University College of Wales, Aberystwyth; Mr. A. I. Eastwood, London wholesale meat trade supervisor of the Ministry of Food; Mr. G. Gibbard, chairman of the Livestock Committee, National Farmers' Union of England and Wales; Mr. W. Graham, president, National Farmers' Union and Chamber of Agriculture for Scotland; Dr. John Hammond, Animal Nutrition Research Institute, University of Cambridge; Mr. J. Mackintosh, National Institute for Research in Dairying, University of Reading; Mr. W. G. R. Paterson, principal, West of Scotland Agricultural College; Mr. T. Peacock, president of the National Farmers' Union of England and Wales; Mr. W. J. Reid, member of the Scottish Agricultural Advisory Council. The Secretary of the Committee is Mr. H. Gardner, of the Ministry of Agriculture and Fisheries.

Registration of Engineers

THE Minister of Labour and National Service has made an order for the compulsory registration of professional engineers. Registration is with the Central Register. It refers to those who are normally engaged in a technical or supervisory capacity in aeronautical, automobile, chemical, civil, structural and municipal, electrical, gas, locomotive or mechanical engineering; and those normally engaged on research work in the engineering sciences at a university or in research and development work in any industry or as a teacher of engineering science. Men whose names are already on the Central Register are not to register again. There are 22,000 names in the engineering categories of the register, of whom about 800 are not in employment, and it is estimated that 30,000 more names will now be added.

The Rise of Turkey

A PAMPHLET "Turkey: the Modern Miracle" by E. W. F. Tomlin, published in "The Thinker's Forum" (London: Watts and Co. 6*d*. net), gives a brief review of the development of Turkey during the nineteenth century and since under Mustapha Kemal. In outlining the reforms introduced under Mustapha Kemal, while pointing out the extent to which Turkey is a totalitarian country with the People's Party as the supreme organization, its constitution is not so autocratic as might be expected. Its activities are not devoted solely to propaganda, and no institution is more democratic than the People's House or Halk Eir. Modern Turkey is impressed throughout with the spirit of youth, and Turkish education is highly practical and surprisingly democratic. The younger generation is encouraged to use its reason. A passage in the official text-book on citizenship used in all the Turkish primary schools runs: "We shall educate our children in a way which makes them capable of using their brains even in unaccustomed circumstances, of taking necessary decisions without waiting for orders from above, of developing a spirit of enterprise and a desire to overcome all difficulties which may block their way". In a tribute to Mustapha Kemal's achievements, Mr. Tomlin points out that he created a new order of society, a society liberated from the bonds of obscurantism, inefficiency and brutalizing superstition, out of material which seemed at the time to be beyond all reclamation.

War, Drunkenness and Suicide

IN a recent paper (*Brit. J. Inebriety*, 38, 28; 1940) based on his experience at H.M. Liverpool Prison which receives male prisoners from a wide area in the north-west of England and North Wales, Dr. Harvie K. Snell discusses the influence of the outbreak of the present War on drunkenness and attempted suicide, the connexion between which has often been stressed. Under the single heading drunkenness he has included not only simple drunkenness but also cases described as drunk and disorderly, drunk in charge of a vehicle and those charged at the same time with begging and common assault. His figures show the somewhat surprising result that there was a definite decline during the first four months of the War as compared with the previous three years in the number of persons admitted to prison for drunkenness or attempted suicide.

These results are in striking contrast with the late Dr. Sullivan's results concerning convictions in women for the same two offences in 1914, which both showed a marked increase after the outbreak of war, but present the same trend as the figures relating to women admitted to the Manchester Prison from an extensive area in the north-west of England and Wales for drunkenness and attempted suicide in the early months of the present War. Dr. Snell attributes the decline in the incidence both of drunkenness and of attempted suicide on the present occasion to economic and social as well as psychological causes, the former including rise in the price of liquor and the condition of the streets in the black-out period, and the latter the lesser degree of emotional strain leading to drunkenness than that which occurred in 1914.

Colonel Kenneth Macleod

COLONEL KENNETH MACLEOD, an eminent military surgeon and hygienist, was born in the Outer Hebrides on July 23, 1840, the son of a Free Church minister. He received his medical training in the University of Edinburgh, where he qualified in 1864. After four years service in the Indian Medical Service, he was appointed secretary to the Inspector-General of Hospitals in 1872 and held this post until 1879. On December 1, 1879, he was made professor of anatomy in the Calcutta Medical College, a post which he held until his retirement in 1892. Macleod did much for the advancement of medicine in India. In 1869 he investigated Indian cattle plague and set about establishing facilities for veterinary research in India, which culminated in the foundation of the Bengal Veterinary College. In addition to his surgical activities, he took an active part in public work. He founded the Calcutta Medical Society, was its first secretary and later its president, and was editor of the *Indian Medical Gazette* during 1871–92. After his return to England on his retirement, he was appointed professor of clinical military medicine at the Army Medical School at Netley, and held this post until 1905. He died on December 17, 1922.

Early Man and Pleistocene Deposits in America

ALTHOUGH it is established by the find in New Mexico of a Folsom projectile point embedded in fossil mammalian vertebræ that early man in America was contemporary with and hunted an extinct form of bison, the absence or ambiguous character of stratigraphical evidence and associations of a majority of finds of early American stone age industries hitherto have made it impossible to determine with certainty either their age or their place in a cultural sequence. The relation of the Folsom point, for example, to the Yuma type, which typologically is simpler or more primitive, remains obscure, though the finds recently reported from the south-western States indicate a possibility of establishing sooner or later a cultural sequence leading up to Folsom man, and this is brought nearer to being realized by the discovery of the so-called Sandia man, whose existence is inferred from artefacts found in the basal layers of a cave of the Sandia Mountains, near Albuquerque, New Mexico. These artefacts would appear to be the earliest relics of human purposive activity as yet discovered on the American continent. Here, during the past three years, numerous relics of an extinct fauna mingled with human artefacts have been found, of which the stratigraphic sequence has been fully established in recent excavations.

Frank C. Hibben, writing in the *Scientific American* of July, gives a brief outline of the sequence of deposits found in the Sandia Cave. It begins with the surface deposits of dust with which were mingled pottery and other relics of the Pueblo age. Beneath this a layer of stalagmite deposited in a pluvial period sealed late Pleistocene deposits, in which debris bone fragments and soil were consolidated into a homogeneous mass by calcium carbonate. In this material were chips of flint, scrapers and points, among them the true Folsom points. Beneath this Folsom layer was a thick deposit of yellow ochreous laminated material, evidently water-borne, deposited in a second pluvial when the cave was not in use. Beneath this, and between it and the floor of the cave, was the accumulation of a dry period showing the earliest evidence of occupancy of the cave—fragments of bone, evidence of fires, and stone implements. The implements include shouldered points, entirely different from the Folsom point, and said to be comparable to European palæolithic types. By a hearth lay a blackened fragment of the jaw of a camel. It would thus appear that the evidence from the Sandia cave not only points to the existence of Folsom man in late Pleistocene times, but also has established on indubitable stratigraphic evidence the appearance of more primitive culture in a considerably earlier period, contemporary with an extinct Pleistocene fauna.

The Canadian Entomological Service

UNDER this title, Dr. Arthur Gibson, Dominion entomologist, Ottawa, has discussed the more important developments in applied entomology in Canada during the past fifty years. His paper is published in the Transactions of the Seventh

International Congress for Entomology, held in Berlin in 1938, pp. 1429–1479. James Fletcher, in 1887, incepted studies on insects injurious to Canadian crops and in that year he became the first Dominion entomologist. Prior to this time he had acted for a few years in an honorary capacity. On Fletcher's death Dr. Gordon Hewitt, of the University of Manchester, succeeded to the post thus vacated: he held office from 1909 until 1920. In the last-named year the death of Hewitt led to the appointment of Mr. (now Dr.) Arthur Gibson as the Dominion entomologist.

The Canadian Entomological Service has steadily developed each year and has attained a commanding position in the Dominion Department of Agriculture at the present day. Both Fletcher and Hewitt contributed much to its growth and their good work has been worthily upheld and extended by Gibson. Field stations and laboratories are maintained at thirty different localities and there are ten plant inspection stations. When, however, it is recollected that the provinces Manitoba, Saskatchewan and Alberta alone, are larger than France, Germany and Italy combined, it will be realized that Canadian entomologists have no lack of problems to contend with. The Dominion Entomological Service now ranks as the most important of its kind in the British Empire.

Vegetative Propagation in Tropical Plantations

THE Imperial Bureau of Horticulture and Plantation Crops, East Malling, has issued Technical Communication 13 on this subject by G. St. Clair Fielden and R. J. Garner. It deals with the vegetative propagation of some fifty-five plantation crops, and follows a previous communication (issued in 1936) dealing with the vegetative propagation of some one hundred fruit varieties grown in the tropics and subtropics. The help of technical experts has been invoked for adequate treatment of such major crops as rubber, coffee, cacao, etc., while the foreign literature has been thoroughly combed for details of propagation of the less familiar, but nevertheless important, crops. One feature of the previous work, which commended it also to workers in temperate regions, is retained and considerably enlarged, namely, the section devoted to methods used in vegetative propagation. The descriptions are supported by simple, clear, line drawings of some seventeen types of graft and seven types of budding commonly used in vegetative propagation. Tropical workers will also be glad of the illustrated detail of the construction of loosely woven potting baskets which have been found so useful a substitute for pots in nursery work in the tropics. For those who wish to study originals, a list of references immediately follows the discussion on the propagation of each particular crop.

Weeding Methods in Teak Plantations

A. L. GRIFFITH, provincial sylviculturist, Madras has recently discussed an investigation into different weeding methods in the formation of teak plantations in areas with a west coast climate (*Indian For. Rec., Sylviculture*, 4, No. 2; Govt. of India Press, New Delhi, 1939). The investigation was carried out on a number of small-scale experiments and four large-scale ones. Five methods of weeding were tried. At the time, the principal method of weeding the young teak was by the expensive way of forking. The experiments carried on since 1932 have demonstrated that the method termed scraping is cheaper and as efficient on light forest soils; and that other methods, such as the cheap weeding by weed cutting alone, are not worth while. Weed cutting by hand is by no means cheap in England. By the scraping method it is said that plantation costs are being reduced by Rs. 10 per acre and the quality is as good as formerly. The scraping is done in 4 ft. strips (2 ft. on each side of the line of plants). Weed growth was not cut before. The scraping is effected with an ordinary *mammoty* (like a pointed spade with a recurved handle), removing about ½ in. of soil and cutting the weed roots at that depth below the original soil-level. The weeds removed are piled on the 2 ft. unweeded strips between the lines without cutting the weed growth on them. Or the operation may be carried out over the complete area, the weeds being then presumably removed.

Equine Encephalomyelitis in U.S.A.

IN an editorial article in *Public Health Reports* of April 5 the writer remarks that though equine encephalomyelitis may have existed for very many years in the United States, attention has recently been focused on it by the epidemic in Massachusetts in 1938 when human cases of encephalitis also occurred. There was, however, no indication of human contact infection in these cases. In 1939 only 8,000 cases of equine encephalomyelitis were reported in the United States, or only about 4 per cent of the number (184,662) reported in 1938. The incidence was 1·1 per 1,000 animals (horses and mules) in the affected counties and a case fatality of 30 per cent. The highest incidence was reported from counties in the far-western and Pacific States, a north-east–south-west strip of the central States and three Atlantic States, New Jersey, North Carolina and Florida. As in previous years, more than 90 per cent of the cases occurred in the summer or early autumn, This seasonal prevalence favours the current view that the principal means of transmission is by blood-sucking insects, especially mosquitoes. The prophylactic value of vaccination with a vaccine of chick embryo tissue is shown by the fact that the incidence of encephalomyelitis in vaccinated horses and mules was 0·37 per 1,000 in the vaccinated as compared with 1·2 in the unvaccinated. Other factors in the reduction of the disease were the retarding of insect breeding and increased resistance owing to previous attacks among the animals.

Vehicle Radio-Telephone Service

IT is reported from Pittsburgh, Pa., that the Bell Telephone Co. has applied for a permit to install transmitters and receivers on what is called a 'tie-up' with existing telephone facilities. The company has applied to the Federal Communications Commission in Washington for permission to place transmitting and receiving equipment on the top of its Pittsburgh building and at certain suburban situations. With this service available, any private or commercial telephone subscriber could converse with the occupants of a properly equipped motor-vehicle moving on the street or highway within a radius of fifteen miles. Each truck or motor-car equipped for the service would have its own telephone number, and would be reached through a special operator, who would handle these calls. It is to be known as the 'vehicular radio-telephone service' (*Elect. Rev.*, June 7).

The Bell Telephone Company's present plans include making the service available to public utility company vehicles and equipment, up to seven of its own vehicles. This would permit quick mobilization and centralized direction of motor vehicles in the event of major emergencies. There are at present limitations on the number of channels available. Otherwise, even at high cost, there would be an appreciable public demand for such telephone installations in privately owned cars. The limitation of the channels will restrict the spread of the service, but in the case of many hospital and police ambulances it should prove very useful.

Rising Cost of Generating Electricity

METHODS are being discussed by electrical engineers to meet the rising costs of generating electricity. Even before the War this was becoming a serious problem. In some cases it had rendered the raising of tariffs inevitable. It apparently was the only alternative to bankruptcy, and the War has certainly not improved the situation. The Electricity Commissioners not long ago published a list of these changes. According to the *Electrical Times* of July 11, Sir Percival Bower, chairman of the Birmingham Electricity Department, made a speech on July 2 in which he stated that his committee is anxious to avoid any increase in tariffs, notwithstanding the formidable increase in costs all round. A fairly large surplus on the last year's accounts is being carried forward to cover any emergency expenditure. Another way of coping with the rise in costs is proposed by Mr. F. H. Whysall of Belfast. If, he says, the department is to pay its way and have a reasonable balance for renewals and reserve accounts, it is impossible to maintain the present low level of charges to the consumer. He intends to recover these increased costs by an equitable method, taking into account the rise in prices of coal, stores and wages. The large consumer is easily assessed, he already has a coal clause in his agreement and he will now feel the effect of other rises in commodities or wages on a similar sliding scale. The principle cannot be applied so precisely to the ordinary consumer, but it happens that an approximation is fairly represented by charging him a round figure of 10 per cent extra for the present, prior to the inclusion of a similar kind of coal clause in his bill. As for the slot-meter house-holder, he will lose his five per cent cash discount.

Development of Rural Electrification in England

SINCE the War began, there is evidence that the sales in Britain of electric milling and dairy equipment have been increasing. In addition, many rural supply authorities find that inquiries as to costs and running expenses of various types of electric motors and pumps are being made on an increasing scale. On the other hand, the extensions to isolated farms will be both more difficult and more costly owing to the rise in the price of materials. In the *Beama* journal of May, it is pointed out that if the War continues for two or three years, it will be necessary for the Government to see that these extensions are carried out in the interests of the better utilization of farm labour. But a question of greater importance is the connexion of farms which are not making a full use of supply mains quite close to them. Just before the War, the most encouraging feature of rural electrification was the willingness of landlords to bear the capital cost of connecting up electric supply, the tenants paying the interest charges. There is also scope for the County War Agricultural Committees to facilitate the group interconnexion of farms. The sanction of the Ministry of Agriculture would have to be sought before these committees could act in this way. The Ministry would probably be sympathetic. Concern is being felt about the problem of threshing on isolated farms, which either possess no tractor or should be making the full use of the farm tractor when it may be desirable to thresh as well. Amongst problems which cripple development of electric power are the high rates customary in times of emergency, and also the cost of the necessary way-leaves negotiations which sometimes, for an isolated farm, cost as much as ten per cent of the total cost of giving supply to the farm.

Agricultural Literature

THE expansion of the Rothamsted Library since the first edition of a catalogue in 1926 has made a new edition necessary (Rothamsted Experimental Station, Harpenden. Library Catalogue of Printed Books and Pamphlets on Agriculture Published between 1471 and 1840. Second Edition 1940. Pp. 293+1 plate. 12*s*. Paper Covers; 15*s*. Cloth Covers). It has been compiled by the librarian, Miss Aslin, who has not merely listed a number of books, but has also added interesting notes on them and their authors. This edition contains two new sections, one including manuscripts and farm account books, the other listing the collection of prints of farm animals which the library possesses.

The catalogue only covers the period 1471–1840, as the books published since the latter date are too numerous to be included in one volume. The period selected is well chosen, for the dates marking its limits are milestones in the history of agriculture. In 1471 the first printed book on agriculture appeared, namely, the Augsburg edition of Petrus Crescentius' "Epistola in librorum comodorum ruralium", and in 1840 Liebig's "Organic Chemistry in its Application to Agriculture and Physiology" was published, thus definitely marking the end of the purely empirical period of agriculture and the beginning of the application of scientific principles. The catalogue is excellently arranged for the use of students: an alphabetical list of English authors and translations is followed by a similar list of foreign authors and translations, and these latter are also catalogued under the headings of their respective countries. This publication is invaluable not only for students of agricultural history and bibliography, but also for students of horticultural history, since there are numerous references to the early herbals and to treatises on gardening, particularly on the cultivation and propagation of fruit trees.

Springtime the Safest Time

UNDER this title the March issue of the *Statistical Bulletin*, which in spite of its austere title is remarkable for the sprightly character of its contents, illustrates the fact that life and limb are safer in the spring than at any other time of the year by the statement that, if all the year were April, the annual toll of fatal accidents in the United States would be 12,500 fewer than it has been in recent years. During the period 1934–37, the average number of deaths daily from accidents, particularly burns, falls and motor accidents in the United States was 285, whereas during the same years the daily average for April was 251, as compared with July, the worst month, when the average daily toll was 367. The deaths in March and May averaged only a few more daily than in April. In conclusion, the writer recommends that the spring should be the season not only for cleaning the house and making necessary repairs, but also for clearing out "the junk of the mind—the complacency of fixed daily habits which are fraught with hazards".

Earthquakes Registered at Hong-Kong

DURING January, twenty-two earthquakes were registered at the Royal Observatory, Hong-Kong, the greatest number on any one day being four on January 6. The greatest shock recorded was probably that of January 17 at 1h. 21m. 25s. G.M.T., which exhibited a full complement of phases, and showed maximum amplitudes of 10·4 mm. on the north–south component and 8·7 mm. on the east–west component of the Milne-Shaw seismographs. The difference in arrival time of the primary and secondary waves for this earthquake was 5 min. 17 sec., which, according to Jeffreys' latest tables (*Mon. Not. Roy. Astro. Soc.*, Geophysical Supplement, 1939, June), on the assumption of a normal depth of focus gives an epicentral distance of just over 33° from Hong-Kong.

Recent Earthquakes

THE United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentres of the earthquakes of June 3 and 5. On the basis of reports from sixteen stations, the provisional epicentre of the earthquake of June 3 was lat. 25° N., long. 110° W., which is in the Gulf of California to the east of the island of San José. On the basis of reports from twenty seismological stations, the epicentre of the earthquake of June 5 was lat. 68° N., long. 138° W. This is in the Richardson range of mountains in the extreme north-west of Canada. Both areas are susceptible to earthquake shocks, having experienced them in the past, and both the earthquakes were comparatively large. The first was registered at Kew on June 3 at 18h. 17m. 43s. G.M.T., and the second on June 5 at 11h. 10m. 59s. G.M.T. The second was the larger, having a maximum ground amplitude of 43 μ at Kew. Further moderately large earthquakes were registered at Kew on June 17, 18, and 22, also on July 1 and 6. Information is awaited from other observatories before details of these shocks can be given.

Leverhulme Research Fellowships for 1940

THE trustees of the Leverhulme research fellowships have made awards tenable for varying periods up to two years, for research in the subjects indicated, to the following, among others: Prof. J. R. Bellerby, formerly Brunner professor of economic science, University of Liverpool, post-War economic reconstruction; Dr. R. M. Davies, lecturer in physics, University College, Aberystwyth, experimental investigations on turbulent flow in an air tunnel (renewal of present fellowship); Dr. A. G. Gaydon, Radiation Gas Research Fellow, Imperial College, London, a spectroscopic study of combustion processes in flames and explosions; Dr. N. A. V. Piercy, reader in aeronautics, University of London, mathematical theory of wing sections; W. H. Warburton, Fircroft College, Bournville, a survey of the North Staffordshire pottery industry.

Announcements

MR. J. C. CROCKER has been appointed head of the Department of Chemistry, Chelsea Polytechnic, London, following the retirement on August 31 next of Mr. C. Dorée, who has held the post during the last sixteen years. Mr. Crocker has been senior lecturer on the staff of the Department of Chemistry for many years, during which time, in addition to taking his share in the preparation of a large number of students for their first degree in the University, he has done highly successful work in the training and direction of research students of the Polytechnic for the higher degree in chemistry of the University of London.

IT is announced by the Institution of Naval Architects that the Institution's Library has now been completed by the erection of the memorial to the late Sir Archibald Denny. The Library is situated at the offices of the Institution at 10 Upper Belgrave Street, London, S.W.1.

DR. FRED C. KOCH, professor of physiological chemistry at the University of Chicago and chairman of the Department of Biochemistry, has been appointed Frank P. Hixon distinguished service professor of chemistry in succession to Dr. Anton J. Carison, who will retire at the end of this year.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Classification of Sub-human Types

DURING the last fifteen years scarcely a year has passed but a new skull has been discovered of a type of primitive man or of a higher ape allied to man's ancestors. We are thus getting a large series of forms which have to be classified, and we are having much new light on the origin of man. Perhaps within a hundred years we may have all the main links between man and an anthropoid such as Dryopithecus, with dozens of forms in side branches, which have left no descendants. But a difficulty will arise in nomenclature.

If we have a line of forms from, say, a primitive Eocene horse like Eohippus to an Oligocene horse like Mesohippus with every connecting link, are we to regard all as belonging to Mesohippus ?

Among the early human types a similar problem is arising. Zuckerman says, "At the present time there does not seem to be any more reason than there was ten years ago for separating generically from one another in classification such archaic types as Sinanthropus, Pithecanthropus, Neanderthal and Rhodesian man"[1]. If these four types are placed in the same genus, that genus will have to be Homo. Zuckerman further suggests that there is "no reason to regard Java man (Pithecanthropus) and Pekin man (Sinanthropus) as generically distinct. This view was reaffirmed last year by Le Gros Clark and has just been restated by von Koenigswald and Weidenreich".

Montandon, on the other hand, considers that Pithecanthropus stands outside the Hominidæ, while he regards Sinanthropus as a more advanced type which is definitely within the Hominid group. While such a difference of opinion exists it would surely be unwise to have the Pekin man called *Homo pekinensis* and placed in the Hominidæ, while an allied species of the same genus is called *Homo erectus* and placed in a different family.

It may be some years before we are in a position to state definitely the affinities of such types as Pithecanthropus and Sinanthropus, and even to be at all sure whether Sinanthropus is closely related to either Neanderthal man or Rhodesian man, and it seems to me nothing will be gained at present by putting all these four types in the genus Homo.

Further, to place Pithecanthropus in the genus Homo commits us to a definite conclusion which may or may not be correct ; and, while the majority of anatomists at present agree in regarding Pithecanthropus as a primitive type of man, there are, and have always been, many who regard it as distinctly sub-human. Even should it prove to be the ancestor of man, I cannot see any reason why it should not be left as Pithecanthropus, while there are very definite objections to placing it in the genus Homo. Pithecanthropus with a brain of 800–950 c.c., an enlarged canine tooth in the male and a diastema in front of it, may belong to the same genus as Dean Swift with a brain of 2,100 c.c., but at present many, and even Dubois himself, still have doubts.

R. BROOM.

Transvaal Museum,
Pretoria.
June 8.

---

[1] NATURE, 143, 511 (1940).

Radioactivity of Be^{10}

WHEN beryllium is bombarded with deuterons, a group of protons is observed, with a range of about 26 cm., which is attributed to the reaction Be^9 (H^2, H^1) Be^{10}. It has been assumed that the product of this reaction is the species which McMillan[1] found in a beryllium target after prolonged bombardment. Recently, Pollard[2] has reported that the activity in question decays with a period of 350 years. This figure was obtained from the number of protons emitted (which indicates the number of beryllium nuclei formed) and the number of electrons from the decaying substance. Further, the latter author found that the maximum electron energy was about 0·75 Mv.

This high electron energy in combination with the long life at once leads to the necessity that the transition involved is at least doubly forbidden, as one can verify by inspection of the Sargent diagram. If this is so, it leads to the conclusion that the ground states for Be^{10} and B^{10} are not both S states as suggested by Feenberg-Wigner and Hund[3], unless a γ-ray follows the transition. In order to obtain further information about the radioactivity of Be^{10}, I tried to produce it by another method which would allow of its concentration in a small amount of matter. For this purpose boron was irradiated with slow or fast neutrons, which leads either to Li^7 and an α-particle, or to Be^{10} and a proton.

To make the method as sensitive as possible, about 700 gm. boric acid were placed around a lithium target which was bombarded with 900 kv. deuterons. The Be^{10} was separated chemically after 10 mgm. beryllium had been added as carrier. The beryllium oxide was tested inside a counter so designed that even very soft particles could be detected. Since the neutron source emitted, at the voltage used, and for a current of 100 μ amp., $1{\cdot}8 \times 10^{10}$ neutrons per second, and the total dose was 700 μ amp.-hours, the total number of neutrons passing through the substance was $4{\cdot}4 \times 10^{14}$. As one electron per second could certainly have been detected, an upper limit for the cross-section of this reaction can be found if Pollard's value for the decay constant is accepted. σ becomes, as calculated from the above figures and the geometry, about $\leq 2 \times 10^{-28}$ cm.^{2} ; this representing a mean value for the inhomogeneous neutron beam.

This value is far smaller than could reasonably be expected, as the reaction is slightly exothermic and should take place with considerable ease with fast neutrons. This result must mean either that the reaction is for some reason extraordinarily improbable, or that the activity observed by Pollard and McMillan is in fact not Be^{10}, since the decay constant determined by Pollard can scarcely be in error by several powers of 10. Support for this last suggestion lies in the circumstance that the activity from a beryllium target has not been identified chemically by the previous observers.

I am greatly obliged to Dr. N. Feather for the loan of his counter and to Mr. W. Birtwhistle for technical assistance.

Note added on proof: R. D. O. Neal and M. Goldhaber (*Phys. Rev.*, 57, 1086) have shown that the observed activity of Be on deuteron bombardment is due to H^3.

E. BRETSCHER.

Cavendish High Tension Laboratory,
Cambridge.
June 29.

---

[1] *Phys. Rev.*, 49, 875 (1936).

[2] *Phys. Rev.* 57, 241 (1940).

[3] See summary Jordan, P., *Ergeb. exakt. Naturw.*, 16, 90.

Cosmic Ray Intensities in Relation to Cyclones and Anticyclones

IN a previous letter[1], we showed that cosmic ray intensities undergo characteristic changes during the passage of cyclones. The computations were carried out for cyclones irrespective of any seasons. Since, however, the paths of cyclones are generally subjected to seasonal variations, it is possible that the seasonal effect of cosmic ray intensities is superimposed on the results there obtained. We therefore followed the procedure as mentioned below, which enables one to eliminate the seasonal effect. The results thus obtained corroborate the previous conclusions. The same method was also applied to anticyclones.

We used nearly the same hourly means of cosmic ray intensities, 362 in number, observed during the traversal of the same 11 typical cyclones as were chosen in the previous letter, the only minor difference being the rejection of two unimportant cases which were disturbed by magnetic storms. The same method of representation on a polar diagram was also followed as before. Instead of writing down, however, the values of cosmic ray intensities themselves on the sections of the diagram corresponding to the positions of Tokyo, we put down their percentage deviations from the mean intensities during the passage of individual cyclones. In this way we obtained the mean percentage deviation for each section as given in Fig. 1, which shows the variation of cosmic ray intensities due to cyclonic migration free from the seasonal effect. As can be seen from the figure, the general features are nearly the same as in Fig. 2 of the previous note, although the magnitude of the variation is less, namely, ± 0·5 per cent in this case.

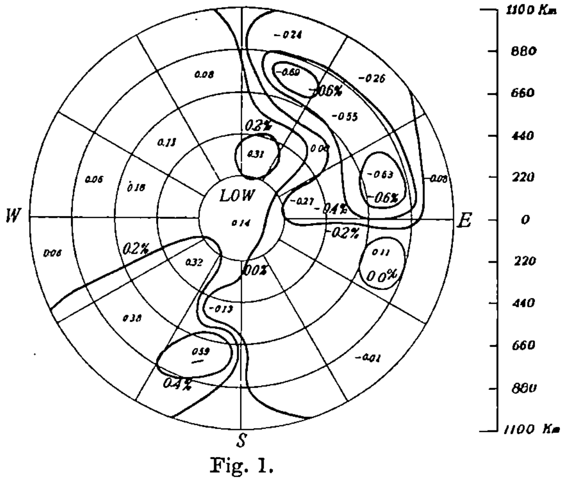


Fig. 1.

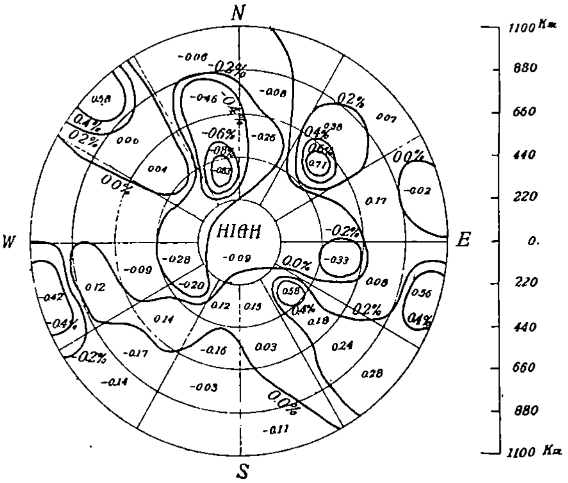


Fig. 2.

Exactly the same procedure was adopted for 25 cases of anticyclones, the centres of which were determinable within a radius of about 1,100 km. from Tokyo as before. Corresponding hourly means of cosmic ray intensities, 598 in number, were treated in the same way as above. The final results thus obtained are given in Fig. 2, in which the distribution of intensity deviations is more complicated than that of Fig. 1. Since the anticyclone traverses the area in question from west-north-west to east-south-east, carrying cold air masses of polar origin in the front and warm air masses of tropical origin in the rear, the general feature of Fig. 2 seems again to illustrate the fact that the arrival of a cold air mass tends to increase the intensity of the hard component of cosmic rays, while that of a warm air mass tends to decrease it, in conformity with the instability of the meson. The high values, however, in the north-west quadrant as well as in the south-west quadrant, as shown in Fig. 2, seem to show that the warm rear of the anticyclone is again followed by a cold air mass. Whether this is due to the cold front of the succeeding anticyclone or to the specific character of the anticyclone itself will be seen in the future.

This work was done as a part of the programme of the Cosmic-Ray Sub-Committee of the Japan Society for the Promotion of Scientific Research.

Y. NISHINA.
Y. SEKIDO.
H. SIMAMURA.
Institute of Physical and Chemical Research,
Tokyo.
H. ARAKAWA.
Central Meteorological Observatory,
Tokyo.
April 22.

---

[1] Nishina, Y., Arakawa, H., Sekido, Y., and Simamura, H., NATURE, 145, 703 (1940).

Crystal Structure of Rochelle Salt

We have succeeded in finding approximate positions for all the atoms of Rochelle salt (sodium potassium tartrate tetrahydrate) in the crystal structure. The unit cell has dimensions 11·93 A. × 14·30 A. × 6·17 A. ($Z = 4$), and the space group is $P2_12_12$. The set of general positions expressing this symmetry is

$$xyz\,;\ \bar{x}\bar{y}z\,;\ \tfrac{1}{2}+x,\ \tfrac{1}{2}-y,\ \bar{z}\,;\ \tfrac{1}{2}-x,\ \tfrac{1}{2}+y,\ \bar{z},$$

and the co-ordinates of the various atoms are as follows (expressed in sixtieths of the cell edges):

2K on	(0 0 3)	4O on	(15 24 51)
2K	(0 30 9)	4O	(3½ 21½ 49)
4Na	(15 0 30)	4OH	(9½ 21½ 19)
4C	(9 11½ 18)	4OH	(15 14 38)
4C	(7 16½ 27)	$4H_2O$	(27 18 1)
4C	(9½ 16 39)	$4H_2O$	(23½ 4½ 30)
4C	(9½ 21 49)	$4H_2O$	(15 3 51)
4O	(7 6 20)	$4H_2O$	(25 24 26)
4O	(13½ 11 8)		

We are not satisfied with the accuracy of these positions; but we have no doubt that our general idea of the structure is correct. It agrees with two-dimensional Fourier syntheses projected down the *a* and *b* axes (the signs of the *F*'s being obtained from intensity changes in the differently substituted salts) and also with a three-dimensional Patterson diagram of the ammonium salt, for which all the intensities were observed. All the interatomic distances are reasonable. The water molecules seem to be either of the three- or the four-bonded type. They co-ordinate the sodium and potassium atoms and assist in bonding these to the tartrate molecule. The tartrate molecule itself has an extended carbon chain with the two identical halves of the molecule lying in two planes inclined at 60° with one another.

It is hoped to derive more accurate positions and to publish a fuller account of the structure very soon.

C. A. Beevers.
W. Hughes.

Dewar Crystallographic Laboratory,
University of Edinburgh.
June 25.

Calculation of Energy Absorbed in Irradiated Tissue

In a previous letter[1], a method was outlined for the volume integration of dosage for X- and gamma-ray beams of radiation. The result of the calculations for a beam of X-rays passing through a 'water phantom' from a 200 kv. Metropolitan-Vickers X-ray tube filtered through 1 mm. copper and 1 mm. aluminium at a focal skin distance of 40 cm. showed the integrated dosage R, to be

$$R = 5{\cdot}6 \times Ar_0 + \frac{Ar_0}{0{\cdot}085}\left(1-e^{-0{\cdot}085(x-5{\cdot}6)}\right), \quad (1)$$

where A is the area of the applicator at the skin surface and r the maximum skin dose for a large applicator (20 cm. × 15 cm.).

When applied clinically, the above formula allows of comparison of energy absorbed by patients during treatment; but for the computation of absolute energy further calculations are necessary. A method of deducing these absolute values using the ionization method of measurement in small air chambers in the irradiated material has been devised by Gray[2], who states that . . . "If secondary beta radiation is being generated in a medium M at a rate E_v ergs/c.c./sec. then the rate of production of ions in a gaseous medium enclosed in a small cavity in M is $J_v = E_v/W\rho$ . . . . (2), where W is the average energy lost by a beta particle per pair of ions produced and ρ is the ratio of the stopping power of M and the gaseous medium for the particles concerned". Since R is the total integrated dosage in a volume V, then $\int_0^V J_v dv = R/t.e$, where e is the charge in E.S.U. on an electron, and t the time in seconds to liberate the charge. The energy absorbed from an X-ray beam passing through a homogeneous medium is therefore

$$E = \frac{R \times W \times \rho}{e} \quad . \quad . \quad (3).$$

The validity of this equation, however, depends on certain definite conditions[2]. On applying these to the present problem, it is seen to be essential that the material of the absorbing phantom and the dosimeter walls have the same value of ρ, and that the ratio of loss of energy of a beta particle producing an ion pair in air and in the medium be known. The results[3] used in the calculation of integrated dosage were obtained by means of dosimeters the walls of which had approximately the same mean atomic number and electronic density as the water of the phantom; but these walls had been rendered conducting with a film of graphite. Thus the assumption that ρ is the same for dosimeter walls and water is not correct, but for clinical work where homogeneity is non-existent, and the electronic density of tissue only approximates to that of water, the results may be regarded as sufficiently accurate.

The ratio of the number of electrons per c.c. in air at N.T.P. and in water is $0{\cdot}858 \times 10^3$; then the quantity of charge T liberated in tissue as compared with air is given by

$$T = R \times 0{\cdot}858 \times 10^3 \text{ E.S.U.}$$

The energy liberated in tissue is $E = \dfrac{R \times W \times 0{\cdot}858 \times 10^3}{4{\cdot}77 \times 10^{-10}}$;

where W, the mean energy required to produce an ion pair in air, is 32·5 eV. or $5{\cdot}2 \times 10^{-11}$ ergs. (Since this letter was written, it has been shown by Lasnitzki and Lea[4] that the relative ionization in tissue for equal ionization in air for gamma and hard X-rays is 1·12; thus the energy absorbed in tissue from the beam considered above is probably 12 per cent greater than the value given.) In water with a mean atomic number of 3·33, W (water) becomes $1{\cdot}04 \times 5{\cdot}2 \times 10^{-11}$ ergs. The expression, therefore, for the total absorption of energy in tissue during irradiation is

$$E = \frac{R \times 1{\cdot}04 \times 5{\cdot}2 \times 10^{-11} \times 0{\cdot}858 \times 10^3}{4{\cdot}77 \times 10^{-10}} \text{ ergs};$$

or $E = 97R$ ergs or $2{\cdot}32 \times 10^{-6}\ R$ calories. This value is necessarily approximate for the reasons stated above, and for absorption in bone modified values of ρ and W have to be introduced.

A more detailed discussion of the above is to be given at a later date.

Frank Happey.

Physics Laboratory,
Radium Centre,
Royal Infirmary,
Sheffield.

---

[1] Happey, F., Nature, 145, 668 (1940).

[2] Gray, L. H., *Proc. Roy. Soc.*, A, 156, 578 (1936).

[3] Parker and Honeyburne, *Brit. J. Rad.*, 8, 684 (1935).

[4] Lasnitzky and Lea, *Brit. J. Rad.*, 13, 149 (1940).

The Evolution of the Stars

Drs. Hoyle and Lyttleton have raised[1] some objections to the results of the application of nuclear physics to the problems of stellar evolution as discussed in my recent articles on this subject[2].

The main difference between the two points of view consists apparently in the fact that, whereas I maintain that the stellar mass remains essentially constant during the evolution, Hoyle and Lyttleton are of the opinion that the stellar energy, although manifestly due to nuclear reactions, actually comes from the cosmical material collected by stars on their way through space. It is easy to see, however, that the rates of accretion as calculated by Hoyle and Lyttleton[3] are too high by a factor of many thousands, because they have not taken into account the thermal motion of the particles of the interstellar gas. This has led them to a formula according to which the amount of matter collected by a moving star is inversely proportional to the cube of its velocity. It is known, however, that, due to the interaction with the light quanta of interstellar radiation[4], these particles must possess thermal velocities as high as 15 km. per sec. (for hydrogen). These high velocities reduce quite considerably the effective cross-section for capture, and the hydrogen collected can scarcely secure more than one twenty-thousandth part of the radiation of typical giants.

Also, I cannot agree with Hoyle and Lyttleton that "the basis of nuclear theory is in need of revision" in order to make possible the building-up processes in the stellar interior. Our present knowledge concerning the possible nuclear reactions is too well established (both experimentally and theoretically) to make any such revision possible. Thus, Weizsäcker's[5] view that the elements are older than the stars remains the only way out.

The remark of Hoyle and Lyttleton that in my articles "no attempt is made to account for the three distinct periodicity groups of pulsating stars" is apparently due to the fact that they have overlooked the whole discussion pertaining to Fig. 2. In fact, the existence (disputed at present) of these three groups represents the best argument in favour of my views.

Finally, I quite agree with Messrs. Hoyle and Lyttleton that the problem of complex stellar groups (binaries and clusters) is still awaiting resolution.

G. Gamow.

George Washington University.
March 1.

[1] Hoyle, F., and Lyttleton, R. A., Nature, 44, 1019 (1939).

[2] Gamow, G., Nature, **144**, 575, 620 (1939).

[3] Hoyle, F., and Lyttleton, R. A., *Proc. Camb. Phil. Soc.*, (4), 35 (1939).

[4] Dunham, T., *Proc. Amer. Phil. Soc.*, 8, 277 (1939).

[5] v. Weizsäcker, C., *Phys. Z.*, 39, 633 (1938).

Prof. Gamow appears to agree with our view that accretion of hydrogen by the stars from the cosmical cloud would be important if the rate were sufficiently rapid to compensate the transmutation of hydrogen within the stars. He believes, however, that the accretion rate is too low for this to be happening in the case of a typical giant by a factor of order 10^4. Since the publication of our initial paper[1] on this problem, we have been able to proceed further with the discussion of the physical aspects of the process, and we have been able to show that in reality the difficulty mentioned by Prof. Gamow does not arise.

The accretion rate is proportional to ρ, the density of the cosmical cloud, and in our earlier papers we took an averaged value for ρ. But in certain regions of the galaxy, for example near the galactic plane, the density is probably much higher than the average for the galaxy as a whole. In addition, it has appeared from recent observational work[2] that the average value of about 2×10^{-23} gm. per c.c. at first taken by us may be too small by a factor of about 4. Combining these effects, we have shown[3] that the density probably exceeds 10^{-21} gm. per c.c. in exceptional regions of the galaxy, and the massive stars are regarded as being confined to these regions, thereby giving a natural explanation of such dynamical features as the marked concentration of massive stars towards the galactic plane. In this way a factor of 10^2 is accounted for from the discrepancy urged by Prof. Gamow.

The remaining factor has arisen on account of the assumption by Prof. Gamow that the cosmical cloud everywhere possesses high thermal energy. It now appears from recent work[3] that in regions of density 10^{-21} gm. per c.c., the presence of even a small proportion of hydrogen molecules (of order 10 per cent, say) will prevent any appreciable temperature being maintained by the cloud. The reason for this is that the translatory energy of motion of the particles of the cloud must be in equilibrium with the internal energy of the molecules, since the thermal and internal energy tend to reach equipartition as a result of collisions within the cloud. Thus the effect of collisions is to excite the vibrational and rotational levels of the $^3\Sigma$ state of the molecules, and this internal energy can be radiated by quadrupole transitions to the ground state of the molecules. In a cloud of density 10^{-21} gm. per c.c., the time between successive exciting collisions of a particular molecule is of order 10^7 sec., whereas the lifetime for a quadrupole transition of the excited molecule is only about 10^2 sec. Consequently the molecules radiate away the energy supplied by selective absorption, and it can readily be shown that the cloud will take up a temperature of approximately $6\sqrt{Tx/y}$, where T is the temperature of the source of radiation illuminating the cloud, x is the proportion of material in ionized form and y is the proportion in molecular form.

For the purpose of applying this result to the accretion process, it is only necessary to show that an appreciable proportion of the cloud is in molecular form at a distance from the star of the order of the capture radius, since it must then follow that the material near the capture radius cannot rise to high temperature either by selective absorption or as a result of collisions caused by the gravitational field of the star. This question is of particular interest in relation to stars of high surface temperature, since these stars emit a relatively large quantity of radiation capable of disrupting the molecules. Consideration of this problem has shown that for such stars a molecule may persist at distances equal to the capture radius, as given by us for these stars[1], provided the density of material through which the star is passing is sufficiently high. A value 10^{-21} gm. per c.c. for the density can be shown to be adequate for the main body of the O and B stars. In a cloud of this density the life-time against disruption by the action of stellar radiation is of order 10^{13} years. For a cloud of density 10^{-23} gm. per c.c. the life-time of the molecules is much shorter, and in large tracts of the galaxy it may well be the case that molecules are easily dissociated and constitute only a very small fraction of the material in these regions. In this case the temperature of the cloud may be expected to rise to 10,000°, in accordance with Eddington's well-known results.

Accordingly, the reference by Prof. Gamow to the observations of Dunham does not necessarily provide evidence of the temperature in the regions of high hydrogen density, since the interstellar calcium and sodium may be as abundant in regions of low hydrogen density as in regions of high hydrogen density, and the interstellar lines of these elements could then be broadened as a result of high thermal temperature in the regions of low hydrogen density.

R. A. Lyttleton.
F. Hoyle.

St. John's College,
Cambridge.
May 16.

---

[1] Hoyle and Lyttleton, *Proc. Camb. Phil. Soc.*, **35**, 405, 592 (1939).

[2] Camm, *Mon. Not. Roy. Astro. Soc.*, **100**, 45 (1939).

[3] In course of publication.

Rust-Resistant Wheats for India

All the three rusts of wheat occur in India. It has been shown that in the plains of India the severe summer heat kills the rust spores and that the wheat crop is infected anew each season by spores blown down from the hills, where wheat is cultivated up to an altitude of about 9,000 ft. above sea-level. The barberry, though common in the hills, seems to play little part in the annual recurrence of black rust[1], and it is the self-sown wheat plants and ratoon tillers from harvested plants in the hilly areas which constitute the most obvious means of carry-over of rusts from year to year.

Since 1935, we have been endeavouring to breed rust-resistant wheats suitable for cultivation in the hilly regions of India, the project being financed by the Imperial Council of Agricultural Research. The greatest obstacle in the way of breeding a rust-resistant wheat has been the total lack of *vulgare* varieties highly resistant to the physiological races of black rust occurring in India. Although the number of physiological races is very small (up to date only six races of black rust, six of brown and nine of yellow have been found in this country), no *vulgare* variety resistant to the most virulent and widespread race 15 or race 40 of black rust was available.

The only wheat then known to possess considerable resistance to these races was the *dicoccum* variety, Khapli. Unfortunately crosses between this and *vulgare* varieties either failed or gave rise to sterile plants only. In only one cross (Reliance × Khapli) did an F_1 plant set grains, and even in this case only two grains were obtained. These two grains gave rise to plants of the Khapli type, and subsequent progenies behaved similarly. In view of this difficulty, a thorough search was instituted for *vulgare* varieties resistant to black rust, and each year a large number of indigenous and imported varieties were tested. We are glad to announce that our search has been successful and that in a batch of *vulgare* varieties, most of them bred at Njoro, kindly supplied by the Director of Agriculture, Kenya, a promising degree of resistance has been found. One of them, *E*. 144, has proved to be highly resistant to races 15 and 40.

It will be seen that in *E*. 144 we have a wheat which should greatly simplify the plant breeder's problem in India so far as black rust is concerned. *E*. 144 has also shown marked resistance to a mixture of all the six races of black rust in the adult stage. *E*. 148 is highly resistant to all the races of yellow rust in the seedling stage.

The varieties are late and under Indian conditions poor in yield and, therefore, unsuitable for direct cultivation. They are, however, invaluable for breeding, and we have already made crosses between these and some of the Indian varieties.

A number of Kenya wheats received through the kindness of Dr. H. Wenholz of New South Wales are also under test. These wheats appear to be different from the foregoing, but also include forms which possess high resistance to rust.

K. C. Mehta.

Department of Botany,
Agra College, Agra.

B. P. Pal.

Section of Economic Botany,
Imperial Agricultural Research Institute,
New Delhi.
May 13.

---

[1] Mehta, K. C., *Ind. J. Agric. Sci.*, **3**, 939 (1933); Scientific Monograph No. 14, Imperial Council of Agricultural Research, India (in the press, 1940).

Plasma Alkali Reserve in the Domestic Fowl

Experiments have been made in this laboratory with the view of tracing the possible influence of egg production on plasma alkali reserve in the domestic fowl. White Wyandotte pullets were fed on a ration supplemented with 5 per cent calcium carbonate, and others on the same ration without this supplement. The plasma alkali reserve (determined by the Van Slyke–Cullen technique) of the birds on the low calcium ration fell slightly at the start, and then remained at a level between 58 and 66 vol. carbon dioxide per cent; the onset of laying did not have any noticeable effect on plasma alkali reserve.

In the case of the pullets on the high calcium ration the plasma alkali reserve rose during the pre-laying period to a level as high as 88 – 89 vol. carbon dioxide per cent. The values remained high during the laying period, but there were indications that heavy laying may affect the level.

These results were clearly due to female reproductive activity, for the plasma alkali reserve of a cock did not vary outside the limits of 62–69 vol. carbon dioxide per cent whichever ration was fed.

Data for the blood composition of laying and non-laying fowl published by Heller and Pursell[1] also suggest a displacement of blood acid-base equilibrium towards the alkaline side in association with laying: in every instance the blood chloride index calculated from their data is lower in the case of laying birds. These observations are of interest in relation to the changes which egg-laying may bring about in the composition of the fowl's skeleton[2] and to Tyler's[3] recent work on the mineral metabolism of bone in the laying fowl.

Pullets receiving rations adequate in calcium carbonate not infrequently display an unexpectedly high Ca/P retention ratio during the pre-laying period[4,5], suggesting that pre-laying storage of calcium can be in forms with a Ca/P ratio higher than that of the skeleton as a whole. Tyler[3] has recently shown that subsequent drafts on skeletal calcium for shell formation fall preferentially on a bone mineral fraction of very high Ca/P ratio, or may withdraw calcium from the skeleton without withdrawal of phosphorus.

It is suggested that, when the calcium carbonate intake is sufficient, laying is preceded by an adjustment of the blood acid-base equilibrium in association with calcium storage, so that the newly deposited bone mineral may have a higher Ca/P ratio than the skeleton as a whole ; this material would presumably be readily available for shell formation. Morgulis[6] has remarked that the carbonate content of bone (and hence its Ca/P ratio) may be related to blood alkali reserve.

The mineral metabolism of birds laying on low calcium rations requires special consideration and may differ from that of birds receiving adequate calcium supplements. It may be significant that serum phosphatase attains very high levels under such conditions[7].

It is hoped to publish a fuller account of these experiments at a future date.

R. H. COMMON.

Chemical Research Division,
Ministry of Agriculture for
Northern Ireland,
Queen's University, Belfast.
June 5.

[1] Heller, V. G., and Pursell, L., *J. Biol. Chem.*, 118, 549 (1937).

[2] Common, R. H., *J. Agric. Sci.*, 28, 347 (1938).

[3] Tyler, C., *Biochem. J.*, 34, 202 (1940).

[4] Common, R. H., *J. Agric. Sci.*, 23, 555 (1933).

[5] Common, R. H., *J. Agric. Sci.*, 26, 85 (1936).

[6] Morgulis, S. J., *J. Biol. Chem.*, 93, 455 (1931).

[7] Common, R. H., *J. Agric. Sci.*, 26, 492 (1936).

Co-existence of Oxidizing and Protective Mechanisms for Vitamin C in Plant Tissues

VITAMIN C occurs exclusively in the reduced state in fresh vegetables. Although enzymes and copper, which oxidize the vitamin, are widely distributed in plants, the vitamin is not oxidized. It would appear, therefore, that there must be some mechanism in plants which prevents the oxidation of the vitamin. Although the existence of such protective mechanism has been established in animal tissues[1], it has not been shown to be of such wide occurrence in plants.

During the course of researches on the nature of ascorbic acid oxidase of vegetables, an interesting observation was made on the existence of a protective mechanism in plants, which protects vitamin C against oxidation. It appears that both the enzyme 'ascorbic acid oxidase' and the protective factor occur together in certain vegetables, and the two factors have been separated from one another.

The procedure adopted in obtaining these two factors separately was to add an equal volume of acetone to the expressed juice obtained from the vegetable, and the precipitate which contained the enzyme was centrifuged and dispersed in water. The acetone extract after centrifugation was evaporated on a water bath in order to drive off the acetone completely and the aqueous extract thus obtained contained the protective factor, which protects vitamin C from oxidation, both in presence and absence of added copper. The course of oxidation was followed manometrically by measuring the oxygen uptake in Warburg respirometers, and by titration with the indophenol dye. These two factors are found to exist together in a number of vegetables investigated, and they can be separated by adopting the above procedure. Some of the typical plants which are found to contain these two factors are *Cucumis sativus*, *Cucurbita maxima* and *Luffa acutangula*.

So far there appears to be no indication in the literature regarding the co-existence of both the factors—the oxidizing and the protective factors—in plants. It is probable that the effect of the enzyme ascorbic acid oxidase present in plants outweighs the action of the protective constituents, so that the influence of the latter on vitamin C is not apparent, when both of them occur together. Hence it would appear that the failure of previous workers to observe any significant amount of protective substances in plants is to be ascribed to the occurrence of ascorbic acid oxidase in association with the protective substances, and without separating the enzyme from the protective constituents, the detection of the latter would not be possible.

Further work on the isolation, purification and the nature of the protective constituents is in progress. Full details of the work will be published elsewhere.

K. V. GIRI.

Andhra University,
Waltair.
P. V. KRISHNAMURTHY.

Andhra Medical College,
Vizagapatam,
India. May 2.

[1] De Caro and Giani, *Z. physiol. Chem.*, 228, 13 (1934): Mawson C. A., *Biochem. J.*, 29, 569 (1935); Giri, K. V., *Biochem. J.*, 33, 309 (1939); Giri, K. V., *Ind. J. Med. Res.*, 27, 685 (1940).

Potassium and Carbohydrate Metabolism

Pulver and Verzár[1] have recently reported that the up-take of glucose by the yeast cell is accompanied by a simultaneous up-take of potassium, and that the latter is liberated again in the course of fermentation. It appears to me that this result has some bearing on the interpretation of certain other findings concerning the relation of potassium to carbohydrate metabolism.

It has been found that the anaerobic fermentation of glucose by baker's yeast increased, on an average, by about 150 per cent if potassium (0·01 *M* potassium chloride) was added to the medium, which contained as other cations hydrogen, ammonium and magnesium[2]. An increase occurred also if an equivalent amount of sodium was added, but it was much smaller. Other investigations have shown that the anaerobic fermentation of glucose by tumour tissue was markedly greater in a medium containing both sodium and potassium (in physiological concentrations) than in a medium containing sodium alone[3,4]. Similar results were obtained with normal tissue, especially brain cortex[4]. Further, it was found that the aerobic fermentation and oxidation of glucose by brain cortex could be increased considerably by the addition of a surplus of potassium to the medium[5,6].

These results have shown that potassium is able to activate the enzymatic breakdown of glucose, but the question was left open how this activation takes place. Pulver and Verzár assume that the inward diffusion of potassium which they have observed is connected with the phosphorylation of glucose as the initial reaction leading to the formation of a polysaccharide which afterwards breaks down. This assumption is supported by the result that substances which retard phosphorylation inhibit the uptake of both glucose and potassium. From this point of view there appear to be at present two main possibilities regarding the explanation of the effect of potassium upon fermentation and oxidation of glucose. Either potassium activates phosphorylation, and thereby the subsequent formation of the supposed polysaccharide, or it activates the breakdown of the latter. In the former case potassium might be bound chemically, while in the latter case it might be adsorbed by the polysaccharide (having probably colloidal properties). In both cases potassium would be liberated again as soon as this compound breaks down.

It must remain for the future to ascertain which of these two possibilities agrees with experimental facts, and to find out the detailed mechanism of the potassium effect for yeast cells as well as animal cells.

A. LASNITZKI.

Department of Physiology,
University of Birmingham.
June 12.

[1] Pulver, R., and Verzár, F., NATURE, 145, 823 (1940).

[2] Lasnitzki, A., and Szörényi, E., *Biochem. J.*, 29, 580 (1935).

[3] Lasnitzki, A., *Biochem. Z.*, 264, 285 (1933).

[4] Lasnitzki, A., *Protoplasma*, 22, 274 (1934).

[5] Ashford, C. A., and Dixon, K. C., *Biochem. J.*, 29, 157 (1935).

[6] Dickens, F., and Greville, G. D., *Biochem. J.*, 29, 1468 (1935).

Advantages of Uranium Fixation in Modern Cytological Technique

An attempt to use uranium as a fixing agent was apparently made as early as 1882 when Schenk[1] noticed that uranium acetate had a mild fixing action and a high degree of penetration. The nitrate and acetate have since been used for special purposes by Cajal[2], Nebel[3] and others. Uranic acid as a substitute for osmic acid was introduced in this laboratory some years ago. Catcheside[4], who kindly carried out a number of tests with this reagent, finally came to the conclusion that, although good fixation could be obtained, the effects were rather erratic, and La Cour[5] later confirmed the views expressed by Catcheside. Semmens[6] first gave a systematic account of the value of uranium as a substitute for osmium in fixatives employed for plant cytology; he also indicated the theoretical grounds for the use of this metal. In a later paper[7] he further pointed out that the erratic fixation previously recorded appeared to be due to the variable composition of the so-called uranic acid of commerce. To overcome this difficulty he proposed the use of sodium diuranate ($Na_2U_2O_7$), a compound that is much easier to standardize.

There has been a marked tendency in recent years towards the use of more simple mixtures than those previously employed for fixing purposes. It may be as well to point out here that simple fixatives will leave the situation much less obscure for those who wish to attempt a biochemical interpretation of cytological results. Extensive trials with numerous types of plant material in this laboratory have led to the decision that Levitsky's[8] chrom-formalin, used for root-tips, gives fixation every bit as good as anything obtained with the more complicated mixtures which include osmic acid. Chrom-formalin, however, does not give such good results with pollen mother cells or with pollen grain divisions, for which the Flemming type of fixative is as a rule more satisfactory. It is a matter of common experience that osmic acid, owing to its high cost, cannot be used for smear preparations made on an extensive scale. For pollen grain divisions and for meiotic material it has been found that sodium diuranate can be very advantageously used in place of osmium tetroxide. 1 per cent chromic acid in which is dissolved 2 per cent of uranium diuranate is now considered to be the most effective mixture and has been used in this laboratory with excellent results.

In the development of the rapid smear methods[9] involving the use of Feulgen light green technique[10], we have tried various combinations of fixing fluids, and as a result of such trials have found that the chrom-uranate mixture not only gives uniform and satisfactory fixation of pollen grains and pollen mother cells but also considerably improves the nucleolar staining, possibly due to the additional mordanting action of the sodium component. It has also been found that this mixture, followed by Newton's gentian violet technique with subsequent chromic mordanting, gives far better preparations which are also more permanent than those obtained by the ordinary method. We therefore strongly recommend the use of sodium diuranate in place of osmium tetroxide in fixing fluids for material that is to be stained by either the Feulgen light green or the gentian violet techniques.

King's College, London,
at the University of Bristol.

P. N. BHADURI.
C. S. SEMMENS.

[1] Schenk, "Bolles Lee", p. 51 (1937).

[2] Cajal, R. Y., "Bolles Lee", p. 320.

[3] Nebel, B. R., *Z. Zellf. mikr. Anat.*, 16, 251 (1932).

[4] Catcheside, D. G., *Genetica*, 17, 313 (1935).

[5] La Cour, L., *Bot. Rev.*, 3, 241 (1937).

[6] Semmens, C. S., *Microscope*, 1, 29 (1937).

[7] Semmens, C. S., *Microscope*, 3, 1 (1939).

[8] Levitsky, G. A., *Bull. Appl. Bot.*, 27, 175 (1931).

[9] Bhaduri, P. N., *J. Roy. Micro. Soc.*, 50 (1940).

[10] Semmens, C. S., and Bhaduri, P. N., *Stain Techn.*, 14, 1 (1939).

Books and Periodicals for Interned Scientific Men

The Government's policy with regard to aliens has resulted in the internment of a very large proportion of the refugee scientists who were in Great Britain. It should be remembered, as has been recently pointed out by the Prime Minister, that though there may be enemies of the country among them, by far the majority are genuine victims of Fascism and amongst its bitterest opponents. Many refugees have made valuable contributions to science whilst in Great Britain, and some of them were actually engaged in work of national importance at the time of their detention.

We are not able to judge the wisdom or value of this indiscriminating internment, but there is one way by which we can lighten the misfortunes of our fellow scientists and mitigate any feeling of bitterness which might arise. This is by supplying them with the books and periodicals which will enable them to keep abreast of new developments in science and play their part efficiently in the reconstruction of the post-War world.

Those in internment camps are only allowed to receive new books and publications direct from the publishing offices, and individuals could arrange for books to be bought and sent to scientists in the camps. Newly published books and periodicals can also be sent to the camp libraries, and learned societies might consider sending copies of their journals to these libraries through the Y.M.C.A.

Such action would be a valuable demonstration of that international spirit of science on which all true scientists set so much store for the future of humanity.

W. A. WOOSTER.
(Hon. General Secretary.)

Association of Scientific Workers,
30 Bedford Row, London, W.C.1.

RESEARCH ITEMS

Prehistoric Village Site, Ontario

THE Lawson prehistoric village site, Middlesex County, Ontario, Canada, had already suffered severely from amateur collectors when it was explored by W. J. Wintemberg during 1921–23, but with the addition of scientifically valuable evidence from private collections it has been possible to reconstruct a picture of the material culture of the inhabitants (*Bull.* 94, Anthrop. Series, 25, Nat. Mus. Canada; 1940). The territory in which the fort is situated is known to have been inhabited by the Neutral Indians of Iroquoian linguistic stock. Probably it had been inhabited long before traders penetrated the region. The site is surrounded by slopes steep on north and south sides, elsewhere less steep. The village probably lay at the east end. Along the north side flows the Medway, a navigable stream, and on the south, Snake Creek, and there is a spring on the west end of the site. Refuse deposits and pits, in groups, of unknown purpose have been found; and there are eleven fireplaces, some round, others oval. The site is strategically important. The east and west ends alone were vulnerable and had to be protected by earthworks. Post-holes for palisades were found along the north and south sides of the site, in places in four rows. The houses were probably like the bark-covered cabins of the Hurons, 2–40 fathoms long and about 4 fathoms wide, and of the same height. Post-holes of small, nearly round habitations, 8–9 ft. in diameter, were found. In the evidence of foodstuffs, animal remains were more numerous than plant remains, but probably both were used in about equal amounts. About 11,000 animal bones were found, including those of mammals, birds, turtles and amphibians, as well as shells of land and freshwater molluscs. About one hundred fish bones were secured. Certain artefacts, animal bones and vegetable products indicate hunting, fishing and agriculture as modes of subsistence. About 14,000 potsherds were found, none, however, permitting reconstruction. Tools consisted of axes, adzes and chisels of stone, antler and teeth, whetstones, rubbers, scrapers, flaking tools, points and hammerstones.

Rock Engravings on the Indus

A SERIES of rock-engravings or chippings were observed in 1931 and succeeding years by Cuthbert King in Attock, the most northerly district of the Punjab Province, India (*Man*, May, 1940). The engravings are on groups of large stones lying on the right (North-West Frontier Province) bank of the Indus about three miles below the Attock bridge near the village of Darwaza. At times of flood and generally during the summer months the rocks are wholly or partially submerged. The stones are of black basalt, and the pictures or marks are pecked on a smooth surface, but not artificially prepared. Local tradition is that the three engraved rocks figured were originally one, which was split by lightning. They certainly show signs of violent fracture, while the technique and subject-matter of the engraving on all three appear uniform in every way. Afterwards, further examples were discovered up-stream, while similar engravings were recorded on rocks near the Haro River about a mile above its junction with the Indus, 1½ miles below the first discovery, and also in the Indus itself above this confluence, but showing slight differences from the Darwaza engravings. Some of the markings show resemblance to Chinese characters, while others resemble stylized figures of Swedish and Spanish rock-engravings. Sir John Marshall, to whom the find was reported, considered them to be of the late historic period, while their similarity to many rock-drawings of the medieval period has been pointed out.

Precautions against American Foul Brood in Bees

CERTAIN aspects in the treatment of American foul brood among bees are discussed in the *Bee World* of June. As in any disease of bees, it is necessary to prevent the bees from carrying infection into a clean hive and also to realize that all infected hives and apparatus require adequate sterilization. If either of these measures be neglected or inadequately carried out, all effort is wasted. Ignorance of the means of infection by a given disease is a potent source of trouble. Thus, until the discovery that *Bacillus pluton* is carried on the mouth-parts of the adult bees, the failure of the most careful measures for controlling American foul brood remained unexplained. In connexion with disinfecting hives, nearly all competent advisors recommend scorching by means of a painter's blow-lamp. This method has its disadvantages, since it is difficult to burn out the corners and crannies without undue burning of the wood. The application of hot washing soda and water is much easier and cheaper to use, but the question arises as to whether it will kill the spores of the disease organism. Apparently a reliable answer to this question is not available and full inquiry is badly needed.

Indian Palæobotany

INDIA has long been known to be very rich in fossil plants, and it is fortunate that there should now be an able Indian palæobotanist with a vigorous school of fellow workers. In a reprinted lecture by B. Sahni ("Recent Advances in Indian Palæobotany", Lucknow University Studies; 1938–39) we have an excellent survey of a field wide enough to include such matters as mountain uplift and continental drift, and in addition a most encouraging promise of fresh results from many pieces of work now in progress. Two of these pieces of work have now appeared ("Jurassic Plants from Afghan Turkistan", by R. V. Sitholey, *Mem. Geol. Surv. Ind.* (*Pal. Indica*), 29, Mem. 1; 1940: "The Fossil Charophyta of the Deccan Inter-trappeans near Rajahmundry (India)", by K. S. Rao and S. R. N. Rao, *ibid.*, Mem. 2); that on the Charophyta provides welcome evidence for the Lower Tertiary rather than Cretaceous age of a very important formation, while Sitholey's work is of value in providing new localities for certain Middle Jurassic species, and though his flora is small, it will be a useful item of information in building up the complicated story of the history of this vast area.

Preservation of Vegetables by Waxing

IT has long been known that a thin film of natural or artificial wax on the surface of plant tissue is effective in reducing its rate of water loss, and commercial processes have been developed, particularly in the citrus industry, which take advantage of this fact, more than 75 per cent of the oranges grown in California and Florida now being treated in this way. The possibility of extending the process to include vegetables which have to be stored for some time before sale is now being investigated and useful results are described by H. Platenius (Cornell Univ. Agric. Exp. Station, N. York, *Bull.* 723). The method which appears to be the most promising is the dipping process, which can be carried out by hand or mechanical equipment. The vegetables are first washed, and without drying are dipped momentarily into a cold wax emulsion at room temperature and then dried thoroughly, the average thickness of the resulting dry film varying from one to two microns. The chemical nature of these emulsions is very complex. Essentially they consist of colloidal suspensions of one or several kinds of waxes in water, the minute particles being kept in the disperse phase by means of a soap. One of the waxes used contained bentonite in addition to paraffin and a soap. Proprietary articles were used in these experiments, and their names, together with those of their manufacturers and partial compositions, are given. A large variety of vegetables were tested. The results obtained with topped carrots and cucumbers were outstandingly good, and in general the process can be recommended for all root crops with the exception of parsnip. The waxing of leafy vegetables is not advised, nor for those which are shipped with ice on top of the container. Waxing does not improve the quality of an inferior product, nor does it prevent the progress of disease; but it does reduce shrinking and maintain the fruit or vegetable in a fresh condition for a longer period than would be possible without treatment.

Rust Fungi of the Genus Prospodium

THE very numerous species of rust fungi form a rather unwieldy taxonomic unit, and it becomes a matter of necessity to sub-divide the Uredinales into convenient sub-groups. One of these, the genus Prospodium, proposed by J. C. Arthur in 1907, has recently been studied in detail by George B. Cummins (*Lloydia*, 3, No. 1, 1–78; The Lloyd Library and Museum, Cincinnati, Ohio, U.S.A., March 1940). Prospodium is separated from the other Uredinales by the picturesque character of possession of appendages to the spore pedicels. This ornate feature is, however, linked to a more fundamental criterion in the limitation of the host range favoured by the genus to Verbenaceæ and Bignoniaceæ. The present discussion attains monographic proportions, with accounts of structure, life-history, taxonomy, a key to the fifty species with a detailed description of each, and the necessary bibliography.

Pleiotropic Effect of Genes

WHETHER genes in general affect only one or a few characters of the organism or whether all genes of an organism affect most characters is an important question in genetics. J. J. Schwab (*Genetics*, 25, 157–178; 1940) has analysed the effect on the shape of the spermatheca of *Drosophila melanogaster* of eleven single mutant strains chosen for convenience of observation. These stocks were continuously backcrossed to an isogenic wild strain and the spermatheca were measured before, during and after the period of backcrossing. Statistical analysis of forty controlled generations, of which twenty were designed to permit crossing-over, was made. It was found that out of eleven segments studied, nine were able to affect the shape of the spermatheca, a character also selected for experimental convenience. Hence "structures may be affected by a multiplicity of genes".

A Fungicidal Fertilizer

S. C. TENG makes the interesting suggestion in *Sinensia* (8, Nos. 5–6; September 1937) that urine be employed as a fungicide, and shows that it is effective against the sclerotinia disease of asparagus lettuce and other maladies. Ammonia is evidently the fungicidal compound, and the liquid is applied during transplantation, at the rate of one litre per square foot of soil. Urine is a common fertilizer in China, and its use as a fungicide in no way diminishes that property.

Constituents of the Higher Fungi

ERGOSTEROL has been isolated from some higher fungi, but so far as was known no well-characterized members of the terpene group, such as the triterpene resinols, had been isolated from fungi. L. C. Cross, C. G. Eliot, I. M. Heilbron and E. R. H. Jones (*J. Chem. Soc.*, 632; 1940) have now examined the birch tree fungus, *Polyporus betulinus* Fr., and after saponification of the extracts have isolated three polyporenic acids, all of which are probably triterpenoid. Two of these (*A* and *B*) appear to be isomeric $C_{30}H_{48}O_4$ acids, and both contain two hydroxyl groups and two ethylenic linkages. The third (*C*) may be identical with gypsogenin, $C_{30}H_{46}O_4$, isolated from Gypsophila and other species of Saponaria.

Earthquakes in the Aleutian Islands

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of the earthquakes of April 16 and May 4, 1940. The shock of April 16 happened at 6h. 7·7m. G.C.T., and, using reports from twenty-six seismograph stations, the epicentre was calculated to be near lat. 52·6° N., long. 173·8° E., which is just to the north-east of Near Island at the extreme western end of the Aleutian Islands. The shock of May 4 occurred at 7h. 24·1m. G.C.T., and from instrumental reports obtained from Weston, Honolulu, Hong Kong, Manila, Sitka, State College (Pa.), Chicago, Fordham College (Alaska) and Burlington the epicentre turned out to be very close to the previous one, namely, lat. 53·0° N., long. 173·0° E., or immediately north of the Island of Attu at the extreme western end of the Aleutian Islands group. Increased seismic activity in the Aleutian Islands has been noticeable during recent months.

Structure of Sulphur Dioxide

THE structure of the sulphur dioxide molecule has been re-investigated by the electron diffraction method by V. Schomaker and D. P. Stevenson (*J. Amer.

Chem. Soc., 62, 1270; 1940), who have obtained improved diffraction photographs and find the following results. The S—O distance is 1·43 ± 0·01 A. and the bond angle O—S—O 120 ± 5°. The entropy determination of Giauque and Stephenson (*ibid.*, 60, 1389; 1938) gave for the product of the three principal moments of inertia of the SO_2 molecule the value $(10 \cdot 58 \pm 0 \cdot 99) \times 10^{-116}$ gm.cm.^{2}, and this value with the above bond distance gives 121° as the bond angle, in excellent agreement with the electron diffraction value.

Configurations of Quadricovalent Complexes

As is well known, the configuration of some 4-covalent complex compounds of metals is tetrahedral, and of others it is planar. G. N. Tyson and S. C. Adams (*J. Amer. Chem. Soc.*, 62, 1228; 1940) have measured the magnetic susceptibilities of salicylaldehyde complexes of copper, nickel and cobalt, and the salicylaldimine complexes of copper and nickel. From the results the following configurations have been assigned to the compounds. Cobaltous and nickelous disalicylaldehyde probably have tetrahedral configurations, nickelous disalicylaldimine is planar, and cupric disalicylaldehyde and cupric disalicylaldimine are probably planar. In the case of the nickelous compounds, the formation of the disalicylaldimine from the disalicylaldehyde involves a change from a tetrahedral to a planar configuration, and this is attended by a marked colour change from green to orange.

Attainment of Very High Pressures

M. JAMES BASSETT has recently described the attainment of pressures of the order 50–75,000 kilograms per sq. cm. (*J. de Phys. et le Radium*, Ser. 8, 1; April 1940). This has been achieved by the use of a special carbide of tungsten, out of which the component parts have largely been made, though steel forms part of the general framework. A special feature of the apparatus is its maintenance at the temperature of liquid air, thus taking advantage of the increased resistance to compression or tension which all metallic bodies exhibit at low temperatures; special precautions are taken to prevent any access or accumulation of moisture. Three diagrams illustrate the main features of the design, but the scale of operations which could be carried out cannot be stated, as no dimensions are given in the text.

Photographic Action of Metals

THE photographic action of certain metals has been fully recognized since the researches of Russell more than forty years ago. J. A. Reboul returns to this subject (*J. de Phys. et le Radium*, Ser. 8, 1; 1940). Further experiments have led him to the view that Russell's working hypothesis is inadequate to account for all of the phenomena which have been observed to date. Russell maintained that the action was due to the presence of hydrogen peroxide. This is allowed by Reboul, who, however, maintains that part of the effect is due to a very 'soft' radiation from the metals themselves; he hazards the view that this radiation is itself excited by cosmic radiation. Such a conclusion is tentative in view of the fact that these phenomena have so far not been examined under conditions which, of themselves, reduce the cosmic radiation to insignificant proportions. The protean character of the phenomena remind the reader of the Volta effect.

The *K* Term and the Galactic Rotational Constant

W. M. SMART has criticized the claims of Plaskett and Pearce to have solved the mystery of the *K* term (*Mon. Not. Roy. Astro. Soc.*, 100, 5; March 1940). Some time ago, Smart offered some criticisms of their work (*Mon. Not. Roy. Astro. Soc.*, 96, 568) and Plaskett accepted the validity of the criticism; but in spite of this, he still maintains that in actual practice a theoretically incorrect procedure is justified by the results. In their investigations, Plaskett and Pearce made use of 132 *B*-type stars lying between galactic longitudes 210° and 330°, known as the Southern Stream, which they believed formed a moving cluster. Smart has shown (*Mon. Not. Roy. Astro Soc.*, 100, 60) that these stars do not form a moving cluster but are merely a normal sample of *B* stars, yielding a solar motion of 19 km./sec. and a *K* term of 5·2 km./sec. The value of $K = 8 \cdot 3$, derived from the stars of this so-called Southern Stream, has very little significance. He now shows that in their earlier paper Plaskett and Pearce gave solutions which were derived from an incomplete equation of condition and are therefore erroneous. The conclusion is that the only information relating to the *K* term of moderate accuracy that survives concerns the normality of the *K* term for the distant stars of Groups 1 and 2. It is impossible to say at present what the value of *K* will be for the nearer stars, included in Groups 3 and 4; this can be obtained when solutions are made for these groups with the corrected equation of condition and without any arbitrary adjustment of the radial velocities. The claim of Plaskett and Pearce to have reduced the *K* term to its gravitational value is not admitted.

Masses of the Stars

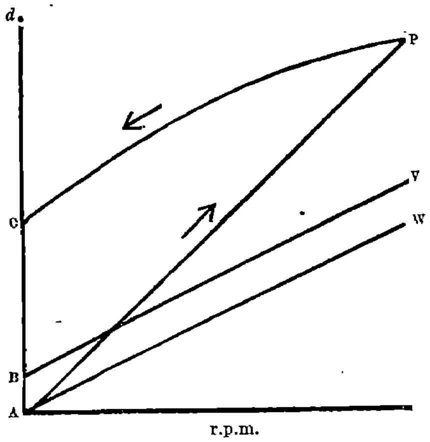
A MONOGRAPH with this title, by Henry Norris Russell and Charlotte E. Moore, has appeared (Chicago: University of Chicago Press. London: Cambridge University Press. 21*s*. net). It is the outcome of a lecture delivered by Prof. Russell in connexion with the Harvard tercentenary and contains all the direct evidence available regarding the masses of the stars, that is, that derived by gravitational motions from binary systems. The first chapter deals with visual binaries and contains a large amount of statistical discussions. A new empirical formula connecting mass with luminosity is given at the end of the chapter, and though it is impossible to provide a complete theoretical explanation of the formula, nevertheless it is available over a wide range, and should be adequate for the computation of stellar parallaxes. Spectroscopic and visual binaries are dealt with in the second chapter, and in the next chapter there is a collection of various discussions under the headings, statistical theory for slow-moving pairs, triple systems, mass ratios, astrophysical conclusions. A curve shows the close agreement between the empirical linear formula connecting mass and luminosity and observational data, and where large discordances exist these correspond to small or poorly determined groups, or to uncertainty in the individual values, as in the case of the "Trumpler stars". Chapter iv presents a new treatment of the determination of dynamical parallaxes and introduces a number of refinements. Tables are also given which facilitate the computation of parallaxes from double-star data. In the last chapter there is a general catalogue of the dynamical parallaxes of 2,529 stars which have been calculated by the methods explained in the previous chapter.

RELATIONS BETWEEN MOLECULAR AND MORPHOLOGICAL SHAPE OF PROTEIN SOLUTIONS

By DR. A. S. C. LAWRENCE, DR. JOSEPH NEEDHAM AND DR. SHIH-CHANG SHEN,
UNIVERSITY OF CAMBRIDGE

THE experiments on which we wish to make the following preliminary report originated from our belief that further knowledge of the shapes of molecules may throw light on the nature of morphological and histological shapes, and the changes which they undergo. We were especially interested in the formation of the neural tube in the amphibian embryo, where this, the first, morphological change in development consists of a great lengthening of the cuboidal ectodermal cells and nuclei to form the cells of the neural plate. The question arises whether this elongation may not depend upon, or be accompanied by, an increase in the number, size, or axial ratio of anisometric protein particles present. With this in mind, we compared the behaviour of protein fractions isolated from amphibian neurulæ with that of other proteins.

The viscosimeter, designed by one of us (A.S.C.L.), consists of an inner cylinder of stainless steel suspended on a torsion wire, and an outer cylinder of stainless steel which can be evenly rotated at speeds varying from 0·5 to 200 revolutions per min., the whole being contained in a jacket allowing of accurate temperature control. The apparatus allows also of simultaneous measurement of flow birefringence. The annular space contains about 15 c.c. when the inner cylinder is just submerged.



The advantages of the Couette (coaxial cylinder) viscosimeter over those of the Ostwald (capillary) viscosimeter are sufficiently well known. The latter gives results from which calculations are scarcely possible since there is no constant rate of shear. Nor is it suitable for studying changes in a solution subjected to known shear forces for varying periods of time. It should also be noted that the study of anomalous flow at low rates of shear is a measure of approximation to complete randomness and hence not interfered with by the simultaneous presence of globular particles, while the study of flow birefringence is interfered with to a much greater extent since it is a measure of approximation to complete orientation in the stream lines.

The results may most conveniently be summarized by reference to the accompanying diagram, which reduces the facts to their simplest form. In the accompanying figure the deflection of the mirror on the torsion wire is plotted against the shear force applied to the solution by the rotation of the outer cylinder. The inner cylinder is not completely submerged. The line *AW* represents that given by water. The line *AP* represents that given by proteins of Class 1. The flow here is normal, and the relative viscosity is therefore constant whatever the shear force. It is to be assumed that proteins of this kind have globular molecules or aggregates. Proteins of Class II, however, give lines such as that shown by *BV*, the reading being abnormally high at low rates of shear and falling off at high rates. Such *anomalous flow* means that the relative viscosity varies with the rate of shear, falling from a very high value to a constant level when perfect orientation of the long particles in the stream lines is attained. On denaturation with guanidine hydrochloride or traces of copper, anomalous flow is completely abolished.

A third class of proteins exhibit more complex behaviour. At first they follow a line similar to that of Class I (*AP*), but when slow speeds are again applied an *anomalous return* is obtained, cutting the abscissa at a much higher level (*PC*). If now this solution is removed from the apparatus, diluted, and put back, anomalous flow, similar to that shown by *BV*, is obtained. It has not as yet been possible to find positive proof that this phenomenon is due to the spinning off of anisometric protein particles from the surface film, but such an explanation appears at present to be the most likely one. That the anomalous return itself is due to the formation of a protein polylayer at the surface on rotation, however, is certain. The formation of such a built-up film, the time-relations of which can be followed in detail, never manifests itself if the inner cylinder is totally submerged, since the torque on the suspension wire is negligible in comparison with that on the cylinder itself.

We have not so far found any protein which showed anomalous flow initially followed by anomalous return.

We are inclined to believe that the initial behaviour of protein solutions of Classes I and III when the inner cylinder is not completely submerged is probably due to a liquid surface monolayer rather than the bulk of the solution, for if the inner cylinder is entirely covered, the concentration of protein needed to obtain equivalent relative viscosities is very greatly increased (for example, from 0·001 to 0·1 per cent). This is not the case, however, in all probability, with proteins of Class II.

We have provisionally placed the proteins studied by us in the following classification :

- Class I. Crystalline methæmoglobin (prep. Dr. Danielli).
  - Crystalline insulin (commercial for physiological use).
- Class III. Crystalline ovo-albumen (prep. Dr. Danielli; many times recrystallized).
  - Myosin (prep. Dr. Bate-Smith. Preparations made in Cambridge, unlike those of Edsall *et al.*[1], show little or no flow birefringence, but appear in all other ways undenatured).
  - Pseudoglobulin from amphibian neurulæ.
  - Aged tobacco-mosaic virus nucleoprotein (which showed less than one-tenth of its original intensity of flow birefringence).
- Class II. Tobacco-mosaic virus nucleoprotein (prep. Dr. Pirie. Here our results are in complete confirmation of those of Robinson[2]).
  - Total globulin fraction from amphibian neurulæ.
  - "Myosin" fraction from amphibian neurulæ.

To the above we should like only to add that we have noted remarkable continuous decreases in relative viscosity of certain protein solutions even when standing at 0° C., notably the amphibian embryo pseudoglobulin fraction. In most of the proteins studied the concentration/viscosity relationship must have the characteristic curves sharply bent between the steep and flat regions, since it is often difficult to hit upon the concentration which will give a relative viscosity in the optimal region for observation.

As regards the embryological significance of our findings, it may be said that they strengthen previous indications (such as those of Miller and Moore[3], Schmidt[4], Needham and Robinson[5], etc.) of the existence of anisometric particles in developing eggs and embryos. Such particles may well be concerned with the shape changes of neural cell formation. The proteins were extracted from embryos frozen at −77° C. and dried *in vacuo* by methods similar to those of Mirsky[6]. Apart from the behaviour of pseudoglobulin, the anomalous flow of the globulin fraction (consisting largely but not entirely of vitellin) invites the question whether vitellin has not been looked upon in the past too exclusively as a nutritive reserve. Yolk-platelets of amphibia were stated long ago by Radlkofer[7] to show weak birefringence. We hope in due course to publish a complete account of the foregoing experiments and to continue the examination of the viscosity of protein solutions both from embryonic and other sources, on which so much remains to be done.

---

[1] Edsall and Mehl, *J. Biol. Chem.*, **133**, 409 (1940).

[2] Robinson, *Proc. Roy. Soc.*, A, **170**, 519 (1939).

[3] Miller and Moore, *Proc. Soc. Exp. Biol. and Med.*, **36**, 835 (1937).

[4] Schmidt., *Ber. Ges. Nat. u. Heilkunde, Giessen*, **17**, 140 (1936).

[5] Needham and Robinson, *C.R. Soc. Biol.*, **126**, 163 (1937).

[6] Mirsky, *Science*, **84**, 333 (1936).

[7] Radlkofer, "Ü. Krystalle proteinartiger Körper pflanzlichen u. thierischen Ursprungs", Leipzig (1859).

MARINE ECOLOGY AT HULL

INVESTIGATIONS on the ecology of plankton in the North Sea and the relationships between the plankton and the fisheries have been made now for some years at the Department of Zoology and Oceanography at University College, Hull, under the direction of Prof. A. C. Hardy. The results of some of this work have been published elsewhere, but recently Prof. Hardy has started a new periodical for oceanographical investigations undertaken by the Department. This is entitled the *Hull Bulletins of Marine Ecology*, of which Nos. 1 and 2 of vol. 1 appeared in November 1939 and vol. 1, No. 3 in March 1940. The publications to date are concerned with research with the continuous plankton recorder. No. 1, which is by Prof. Hardy, contains an account of the ingenious recording machine and the method of working it, together with a summary of the plan and scope of the survey made with the instrument. A number of collecting lines have been run across the North Sea at regular intervals of time, and No. 2 of the *Hull Bulletins* contains a list of records made from 1932 until 1937.

The idea of the survey is to attempt "to apply methods similar to those employed in meteorology to a study of the changing plankton distribution, its causes and effects". In this respect it has considerable bearing on problems of the economic fisheries, such as the influence of the amount of plankton in any one area and at any one time on the survival of young fish and the movements of shoals of adults. At the same time the collections provide an index of the movements of water masses as indicated by the contained plankton organisms. No. 3, by C. E. Lucas, contains an account of the distribution of the phytoplankton in the southern North Sea in 1932–37 as shown by the continuous recorder. The report is chiefly in the form of data on which comparisons of different years may be based, and interesting differences are already apparent. Any full consideration of the results must, however, naturally await the final working up and correlation of all the material available.

The scheme of research undertaken by Prof. Hardy was ambitious, and he will earn the gratitude of oceanographers for having carried it through with such signal success. The results already published show good prospects that, given the funds and opportunity, the continuous observation of certain aspects of oceanography on meteorological lines is a possibility.

It is most regrettable that the War has brought these observations temporarily to a close, and when times of peace return they should be restarted and extended over even wider areas. The *Hull Bulletins of Marine Ecology* will form an important addition to oceanographical literature: it would be most unfortunate if, as suggested on their cover, they only formed a completed work of one or two volumes. In welcoming the new serial the hope may, therefore, be expressed that in due course it will become a permanent addition to publications devoted to oceanographical research, for in Great Britain the number of such journals is at present far from adequate.

NATIONAL RESEARCH COUNCIL OF CANADA

THE twenty-second annual report of the National Research Council of Canada for the year 1938–39 includes the report of the president, Major-General A. G. L. McNaughton, together with the financial statement printed both in French and in English. The review of activities of the Council has this year been published separately.

The president's report refers briefly to work in the Division of Biology and Agriculture on difficulties experienced in the curing and transport of 'Wiltshire bacon' intended for the British market, as well as to other researches on the storage and transport of food. A report on the comparative malting qualities of nineteen barley varieties grown in Canada has been issued in co-operation with the University of Manitoba, and improved methods of predicting the malting qualities of new barleys have been worked out so that satisfactory results can be obtained from small samples. Much progress has been made with investigations on the practical applications of plant hormones, and a commercial hormone powder is now on the market. Promising results have been obtained in co-operation with the Central Experimental Farm in producing a hardy, large-seeded perennial forage plant for the drought areas by crossing wheat with wheat grasses. A new apparatus has been constructed for the measurement of gas production of fermenting doughs with the view of improving baking practice.

In the Division of Chemistry, which has been reorganized during the year, tests were carried out in regard to the production in Canada of face-pieces for gas masks, as well as on the construction and testing of gas-mask containers and the production of adsorbent charcoal. The investigation of domestic barks as sources of tanning extracts continued, and a thorough study was made of the factors entering into the preparation from skimmed milk of rennet casein of a quality suitable for the manufacture of plastics, particularly buttons. Tests are being carried out on the treatment of casein to render it suitable for high-speed injection moulding. Progress in work on magnesium products in the laboratory has been so marked that payments to Canadian railways for freight on the products from the co-operative companies' plants each year now amount to almost as much as the total sum spent on the investigation since the work commenced more than twelve years ago. Fundamental information regarding plasticizing agents has been successfully applied to several types of acid, basic and neutral refractory cements, which are now being manufactured commercially. Laboratory work on the production of asbestos fibre for filtration purposes has been completed and filtration tests carried out on the material. A satisfactory laboratory method for the synthesis of organic selenides has been developed, and the value of selenium compounds as anti-knock agents for motor fuels is being investigated.

Work on the snow performance of aircraft skis has continued, and the Council participated in a comprehensive investigation of aviation fuels under the auspices of the Society of Automotive Engineers. Much work was done for Government Departments, especially on aircraft instruments for the Department of National Defence. Models of ships for Government service were tested by naval architects in the model testing basin.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHER OF PRODUCTION ENGINEERING—The Principal, Dolcoath Technical School, Camborne, Cornwall (July 31).

DEMONSTRATOR (male) in the Department of Physiology—The Medical School Secretary, Middlesex Hospital, W.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1939. Pp. 160+7 plates. (Bristol: The University). [206

Freshwater Biological Association of the British Empire. Eighth Annual Report for the Year ending 31st March 1940. Pp. 82. (Ambleside: Freshwater Biological Association.) 1*s*. 6*d*. [246

Ministry of Agriculture and Fisheries. "Growmore" Bulletin No. 3: Preserves from the Garden. By B. Alice Crang and Margery Mason. Pp. ii+30. (London: H.M. Stationery Office.) 4*d*. net. [246

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1939. Pp. iv+630+4 plates. (London: H.M. Stationery Office.) 15*s*. net. [256

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1940. Pp. 32. (London: Lister Institute.) [276

Ministry of Home Security. Air Raids: What you must Know, What you must Do. Pp. 64. (London: H.M. Stationery Office.) 3*d*. net. [27

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: National Museum of Canada. Bulletin No. 94 (Anthropological Series No. 25): Lawson Prehistoric Village Site, Middlesex County, Ontario. By W. J. Wintenberg. Pp. iv+104. 25 cents. Bulletin No. 95: Annual Report of the National Museum for the Fiscal Year 1938–39. Pp. 24. 10 cents. (Ottawa: King's Printer.) [176

Canada: Department of Mines and Resources: Bureau of Geology and Topography, Geological Survey. Memoir 219: Halfway Lake—Beresford Lake Area, Manitoba. By C. H. Stockwell and C. S. Lord. Pp. vi+68+1 plate. 25 cents. Memoir 220: Mining Industry of Yukon, 1938. By H. S. Bostock. Pp. iv+18+3 plates. 10 cents. (Ottawa: King's Printer.) [176

Commonwealth of Australia. Thirteenth Annual Report of the Council for Scientific and Industrial Research for the Year 1938–39. Pp. 110. (Canberra: Commonwealth Government Printer.) 4*s*. 6*d*. [206

Proceedings of the United States National Museum. Vol. 88, No. 3078: Trematodes from Fishes mainly from the Woods Hole Region, Massachusetts. By Edwin Linton. Pp. 172+26 plates. (Washington, D.C.: Government Printing Office.) [206

Southern Rhodesia Geological Survey. Short Report No. 31: Geological Report on the Norton Gold Belt. By R. Tyndale-Biscoe. Pp. 10. (Salisbury: Government Printer.) [246

The South African Journal of Science. Vol. 36: Being the Report of the Thirty-seventh Annual Meeting of the South African Association for the Advancement of Science, East London, July 3–8, 1939. Pp. xx+578. (Johannesburg: South African Association for the Advancement of Science.) 30*s*. net. [246

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1939. Pp. 38. (Entebbe: Government Printer.) 2*s*. [246

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1939. Pp. 28. (Zomba: Government Printer.) [246

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 30: Biological Notes on Indian Parasitic Chalcidoidea. By Dr. Hem Singh Pruthi and M. S. Mani. Pp. 50+22 plates. (Delhi: Manager of Publications.) 3.6 rupees; 5*s*. 6*d*. [246

Report of the Botanical Survey of India for 1938–39. Pp. 14. (Calcutta: Government of India Press.) [246

Memoirs of the Geological Survey of India. Vol. 75: A Catalogue of Meteorites, with Special Reference to Indian Falls and Finds and to Specimens in the Indian Museum, Calcutta, as on August 1st, 1939. By Dr. A. L. Coulson. Pp. iv+346+6 plates. (Calcutta: Geological Survey of India.) 4.8 rupees; 7*s*. [246

Memoirs of the Royal Asiatic Society of Bengal. Vol. 12, No. 2: The Alleged Pugnacity of the Swordfish and the Spearfishes as shown by their Attacks on Vessels. (A Study of their Behavior and the Structures which make possible these Attacks.) By E. W. Gudger. Pp. 215–315+plates 3–9. (Calcutta: Royal Asiatic Society of Bengal.) 7.14 rupees. [246

Year-Book of the Royal Asiatic Society of Bengal for 1939. Vol. 6, 1940. Pp. 208. (Calcutta: Royal Asiatic Society of Bengal.) 4.14 rupees. [266

Annual Report of the Indian Central Cotton Committee for the Year ending 31st August 1939. Pp. iv+192. (Bombay: Indian Central Cotton Committee.) 2 rupees. [266

Summary Proceedings of the Forty-first Meeting of the Indian Central Cotton Committee, held on the 19th and 20th January 1940. Pp. 60. (Bombay: Indian Central Cotton Committee.) 1 rupee. [266

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, JULY 27, 1940 No. 3691

MEN OF SCIENCE AND THE WAR

SINCE the War, and in the months preceding it, it has been repeatedly urged in these columns that the times demand the maximum use of science and the full recognition by men of science of their social responsibilities. A year before the unstable international situation resolved itself into the present disastrous conflict, pages of NATURE were devoted to statements by the scientific leaders of the country about the urgent need for scientific workers to undertake these responsibilities, but little of practical import has resulted so far. If the War succeeds in arousing certain men of science to a realization of the social implications of their work, then it may be said that some good has come out of it, and it is to be hoped that such will be lasting. Men of science are proving invaluable at the present time; may their value still be recognized when the time for reconstruction comes.

With the War, the country implicitly assumed a reorganization so profound that the full realization of its meaning only dawned in most minds after the disasters of Norway, Flanders and France, and with the victorious onrush of the German war-machine. To-day no persuasion is needed to impress on people the necessity for making all possible use of the country's powers and resources. That message rings in our ears daily. But no efforts, however heroic, however widespread, and however energetic, will succeed in their objects without right direction—and such direction demands the full use of science.

The Germans have demonstrated that this is a mechanized and technical war. It is not sufficient therefore for us to have limitless material resources; it is essential to use them in a thoroughly planned and integrated way. Until now (and this is still the case), planning has been the task of our political and industrial leaders and of the Civil Service alone. There is no need for us to dwell on the results of their efforts. As men of science our responsibility to-day is to see that things get done, not to blame others if they have not been done.

The important part that men of science have already played in this War has been amply recognized in these columns. The Scientific and Research Departments of the Services, the Department of Scientific and Industrial Research and its kindred bodies, and the Medical Research Council, fortified as they have been by the addition of many academic men of science, have been fulfilling their appointed duties. But many scientific workers have not been used at all, and others, who have for long been in Government service, or who have been recruited since the War, are not being used to their fullest capacities. The fundamental reason for this (and this is the fundamental defect of the whole organization) is that the functions of science have been generally conceived, to a large extent even by men of science themselves, in altogether too restricted a way. A general scientific point of view is foreign to the direction of the country, and in particular to its administrators. If this defect is to be remedied, men of science themselves must show the way.

On p. 112 of this issue is reviewed a book which deals with this very problem. One of its lessons is that in order to discover what are the urgent problems before us, and to determine their order of importance, it is first necessary to survey the whole field of national resources and national effort. This object will not be successfully achieved by administrative methods alone, and such methods so far constitute the only treatment of this particular question. They can lead no further than to a statement of the most apparent facts, whereas there is little doubt that a scientific approach would often reveal key problems, the solutions of which would advance matters more rapidly, and with less effort than any amount of energy directed along traditional paths. But if we are to achieve the best from a scientific approach to a fundamental survey of the problems before us, it is essential that the man of science should be given effective authority to make comprehensive inquiries, to formulate and to solve problems and, not less, to see that the solutions which he suggests are embodied in practical measures.

The above-mentioned book provides several examples where this approach has already been used successfully (for example, in dealing with the magnetic mine and with war diseases), and it indicates several others where it could be applied with all promise of success (for example, in dealing with the menace of tanks and providing an adequate food supply from domestic sources). It is apparent that the book refers, partly for reasons of space and partly because of the limitations imposed by the need for secrecy, to only a few of the many problems which could be tackled more vigorously than they seem to be at present; and the issues discussed are mainly detailed ones. More general problems are only hinted at, for clearly without the proper general fundamental survey no one is in a position to state them explicitly.

Since May, the circumstances for making full use of science have grown more favourable than ever before in the history of Great Britain. Complacency has given way to an acute appreciation of the fact that we have urgent unfulfilled needs, and failure has shown the inadequacy of traditional methods. Blame has very rightly been laid on administrators and industrial leaders for failing to achieve the desired results; but for us the lesson is rather in the failure of men of science to realize both the power that lies in their hands and their responsibility for using it. Men of science can no longer be complacent about neglect, or content with such notice as merely seeks their advice about particular issues. With few exceptions they have not regarded it as their duty to force on an unscientific administration their reading of the dangers and of the means for counteracting them. They have regarded their functions as served when their advice has been sought and given. It was not for them to see that it was acted upon. As "J. S. H." points out on p. 113, "half the battle in science consists in asking new questions which the non-scientist cannot be expected to think of".

More than this is demanded to-day. "Go to it," in the words of the new Government slogan, applies not only to the factory worker carrying out his routine duties. It applies even more to the scientific worker—demanding of him initiative, organizing ability and drive, and the clear realization that only with the help of these can the forces of reaction and inertia be turned aside, and our war effort rapidly brought to a successful end.

HOURS OF WORK AND EFFICIENCY

DURING the nineteenth century, industrial development was governed by the claims of machinery rather than of man. It was a period of gradually increasing control of the environment through machines; at the same time, the studies made in the natural sciences and the growing knowledge of the mechanism of the body all tended to focus interest on man's likeness to a machine. Being *like* is not, however, equivalent to being *nothing but.*

The phrase "the human machine", which rightly interpreted refers to part of man's structure, became by implication rather than by design synonymous with man himself. The idea is very old, but the actual form of the expression dates from the eighteenth century when La Mettrie published "L'Homme Machine"; he also wrote "L'Homme Plante", but nobody seems to have been interested in man as a plant.

The almost incredible result of this point of view is reflected in the treatment of industrial workers at the beginning of the nineteenth century, when even children worked in the mills for nineteen hours a day. One might indeed argue that human beings were considered inferior to machines, since care was taken to keep the latter fit.

The problem of munition production during the War of 1914–18 challenged the adequacy of this point of view. Industrial operations at the beginning of the period were implicitly based on a misguided application of arithmetic. If one unit of work could be done in one hour, then 2 would be done in 2, 3 in 3, 8 in 8, 10 in 10, 12 in 12. The physiological necessity for sleep limited the indefinite extension of this principle. It was therefore an easy problem to find out how many units would be done in 100 hours by 100 men. The discrepancy between the expected and the observed output led to inquiry, resulting in a change of interest from the machine to the worker of the machine. The Health of Munition Workers' Committee was set up "to consider and advise on questions of industrial fatigue and other matters affecting the personal health and efficiency of workers in munition factories and workshops". The Committee found that "the ordinary restrictions on hours of employment were widely relaxed. Sunday labour, previously forbidden for women and young persons, and practically unknown for men, except for a few continuous processes, became common". Men were employed for 70–90 hours a week as a common occurrence, more than 90 hours were not infrequent, and there were cases of even 100 hours.

After investigation, the Committee reported that the "munition workers in general have been allowed to reach a state of reduced efficiency and lowered health which might have been avoided without reduction of output by attention to the details of daily and weekly rests".

The research work conducted by this Committee into the relationship of output to hours of work is now historical. It is, of course, true that, within certain limits, an increase in the hours of work will increase the output ; more work can be done in five hours than in two hours, but if eight hours work produces eight times as many units of work as one hour, will ten, eleven and twelve produce the equivalent increase ? A study of munition work in the War of 1914–18 showed that, in the long run, it did not.

After the War, a number of trades were studied from this point of view and confirmed the wartime experience that : (1) An extension of the usual hours of work—except for short emergency periods—does not give a proportional increase. (2) After a prolonged period of overtime which has led to reduction in output, a return to the normal number of hours does not result immediately in improvement. In some cases three months were required before normal output was restored.

The using up of too much reserve energy left the worker unable to put out his maximum effort, or rather his maximum effort was much below his previous maximum. The effect of excessive hours does not show itself always or solely in a reduction of quantity ; in some processes the quantity might be maintained but the quality could be affected, or sickness absence might be increased, and just when adequate nourishment was most important, workers would describe themselves as "too tired to eat". These general statements are the expression of a number of statistical surveys and numerous interviews.

A group of people frequently overlooked in discussions on output and hours are the highly skilled individual workers and those holding managerial posts. The reason is that, owing to the nature of their work, it is impossible to obtain statistical evidence. Since it is a hard fact that continuous human activity, whether physical or mental, is associated with diminished success at that activity wherever it has been measured, these workers will, as others, be subject to this diminished success. The well-known work curve, that is, gradually increasing success, followed by stability and then gradually diminishing success, has been shown to be true of various activities both physical and mental. On the mental side, fatigue may show itself as irritability ; should the irritable person be the head of an organization or department, the consequences of his irritability, probably directed against his subordinates, may be very serious. Work demanding close attention, high intelligence always alert, and swift impersonal decisions will be very much affected by the condition resulting from physical and mental fatigue.

The expressions of fatigue, namely, diminished efficiency, weariness and an appearance of listlessness may be present when the work is light and hours normal. This condition is due not to the using up of reserve energy, but to lack of interest due to absence of change. Modern methods of production have tended in a number of processes to reduce the opportunities for relaxation and change. Work becomes monotonous and the worker is bored. The remedy for this condition is change either in the work or in the conditions of the work.

In a letter from the Association of Scientific Workers published in NATURE of June 29, it is stated that scientific staffs have, during the recent emergency, been working the same long hours as the factory workers. One reason for this may well have been psychological. Assuming that an organization employs a considerable number of scientific workers in the same building as the factory workers, it would have been worth while, for the sake of the general morale, to make no difference for the emergency period between the different staffs, even though the extra hours were not so urgently necessary in all departments. It needs little imagination to hear a tired factory worker working a seven-day week and seeing the scientific staff going off as usual express his views of the latter in strong language. It is also possible that, for the emergency period, the extra hours were necessary for all staffs. At the risk of some fatigue, the effort that by general consent was urgently needed at that moment had to be made. In any event, emergencies are not occasions for explanations.

From several of the statements which have been made during the past few weeks, it has been clear that the Minister of Labour, Mr. Ernest Bevin, is fully aware of the possibility of defeating the end by excessive hours. The explanation is probably in the fact, not generally realized, that Mr. Bevin was for several years a member of the Industrial Health Research Board. Relaxation of the original heavy demands were made after a very short interval, and now we have the announcement that the restrictions imposed by the Factory Acts are to be re-imposed next month.

Experimental evidence on the relation of hours of work to mental work is much more difficult to determine, since an adequate standard of comparison is lacking. Where output cannot be measured, indirect measures, never so convincing practically, have to be used. In the industrial world, sickness absence and labour wastage are useful indexes at times. It is rare though that adequate records are kept for those whose work is generally called 'mental'. In two fairly large scientific organizations with sickness records that were strictly comparable, one had a low sickness rate and the other a high one, the reasons being as usual complicated.

Some years ago an experiment was conducted by a scientific worker with the aim of showing the relationship between loss of sleep and mental efficiency. Since the loss of sleep involved working extra hours—merely being awake acquiescing in existence was avoided—the results may be relevant. The mental efficiency was measured by tests involving speed and accuracy of movement, close attention, memory for rational relationships and mechanical memory, for all of which the normal variations had been determined over a period of many weeks. The results of a number of experiments showed that both speed and accuracy were reduced, that the capacity to see relationships was weakened and that memory became increasingly fallible. It also appeared that there was a disproportionate period of reduced efficiency after the loss of sleep had been compensated. This is quite in harmony with the industrial findings using output as a measure. This example may have some bearing on the problem of the intellectual worker, though since it was limited to one person, its results cannot be generalized.

It is perhaps worth noting that fatigue in itself is not bad but has an important and positive function in protecting the organism against its own tendency to excess. As the Health of Munitions Workers' Committee put it: "The true test of an excessive fatigue is its progressive character, so that during normal rest and recreation the effect is not abolished".

Another point to be remembered in all discussions on hours of work, is that most of the general statements that are valid statistically refer to large numbers engaged on the same work, so that the final expression represents the general trend of a group. Where in addition individual output curves are obtained, there is found to be considerable individual variation in the form of output curves.

If organizations employing scientific staffs as well as others arrange their work on the model of routine workers, they run the risk of having routine scientific workers whose initiative and creative ability has been denied expression and who are therefore a loss to the community. Thus while we make no claim on behalf of scientific workers for preferential treatment at a time like the present, it is clear that their reactions, and those of others normally engaged in intellectual, as distinct from manual work, to long-continued and regular increase of hours, are not established, and care must be exercised lest increased hours defeat the purpose in view. Decrease in effectiveness, or of output, will result from undue pressure, whether it is imposed from outside or by the worker himself; and this must be guarded against if the efficiency of our war-effort is to be maintained.

McLENNAN: A PIONEER OF CANADIAN SCIENCE

Sir John Cunningham McLennan

A Memoir. By H. H. Langton. With a Chapter on his Scientific Work by E. F. Burton. Pp. viii + 124 + 13 plates. (Toronto: University of Toronto Press; London: Oxford University Press, 1939.) 11*s.* 6*d.* net.

IT requires a mental effort for the present generation of Englishmen when they see the highly industrialized communities on the other side of the Atlantic to realize how rapidly these have grown up. At a dinner given to the contributors to the eleventh edition of the "Encyclopædia Britannica", there was a printed paper of extracts from the first edition, and the entire article on Canada ran somewhat as follows: "*Canada.* A vast wilderness to the north of the American Colonies." When Sir John McLennan began his career, Canada had indeed made some progress in geology, and perhaps in other branches of natural history—but Canadian physics was practically non-existent. His biography is a valuable contribution to the history of how it came into being, and his work, combined with the work of Callendar and Rutherford at Montreal, is perhaps the most important part of the story.

In this book, we can learn what has scarcely been known in England, the story of his early years and the difficulties he had to overcome to get such training in physics as could then be had in his native country. It is an interesting question how far men with real scientific aptitude can be kept back for want of early opportunity. McLennan, though of course scarcely to be classed with Faraday or Pasteur in achievement, accomplished fine work with little more initial advantage than fell to them. It was when he arrived at the Cavendish Laboratory in 1898 that I first had the privilege of knowing him. His manner had the same quiet impressiveness as later. Not that he, or any of us, were unduly solemn for our years: I remember Rutherford asking if he had brought his scalping knife with him.

We were all impressed in those early days with McLennan's dogged tenacity in the rather difficult piece of work assigned to him. This book brings out what great energy he put into everything he set his hand to. It is interesting to learn that he sometimes had regrets that he had not found his way into politics. He might well have succeeded in it, for he was at least as much at home in dealing with men as in struggling with physical apparatus. In particular, McLennan had genuine interest in, and friendship for, young people, and at once established the right relation with them. No doubt this was a great factor in his success in building up the School of Physics in Toronto.

His best scientific work was his identification of the origin of the green auroral line. This and other parts of his scientific work are relegated for the most part to an appendix by his successor, Prof. E. F. Burton. I think, however, that it is a pity that this subject was not treated more freely and fully. The way that this line appears bright and apparently isolated when the aurora is examined in a pocket spectroscope, while at the same time not a trace of it can be seen in the spectrum of any of the atmospheric gases, or of air itself as ordinarily observed, formed a most stimulating mystery, far more intriguing than the artificial mysteries of detective stories. It had puzzled two generations of physicists. McLennan solved it, and this by itself ensures that his name will not be forgotten.

The work that was done in the Toronto laboratory was nearly all published by McLennan jointly with younger authors. He explained to me that he was only too glad to let them work out their own problems in their own way and publish independently if they were able; but he found that they nearly always came to him for guidance as to what they should do, and how they should do it. He sat up late night after night reading contemporary papers from the literature, to get suggestions for the work to be done, and the burden of this, on the top of teaching and administrative duties, became very heavy as the years went on. In the early days of his retirement, he appreciated the relief of discontinuing it. But his retiring years were clouded by domestic anxiety and bereavement. He bore up bravely, and as well as he was able. But he said that things no longer seemed worth while.

It is a matter of satisfaction that a connected account of his career should now be available. We could have wished that more of his talk, his methods of work, and his reaction to things and people could have found a place in the record. Kindly though he was to his friends, he was not averse to explaining how he had got the better of anyone who opposed or obstructed him. But it is regrettably seldom that anything of that kind finds its way into a biography. The difficulty is that for so long as such things are fresh in living memories which can relate them, there are the susceptibilities of living people to be considered.

RAYLEIGH.

SCIENCE IN WAR

Science in War
(Penguin Special, S. 74.) Pp. 140. (Harmondsworth: Penguin Books, 1940.) 6*d.*

THIS is a tract for the times, which every scientific worker should read. There will often be disagreement with the views advanced, but it is eminently desirable that they should be aired. The main thesis of the book is that Great Britain has not learned the scientific lesson of the war of 1914–18 nearly so well as Germany, and that part of the responsibility for this state of affairs lies at the door of men of science themselves.

The real scientific lesson of 1914–18 was not that science should be more liberally employed by this or that department for particular problems, but that a scientific approach is needed to the problem of war in its entirety.

This book, which is by twenty-five anonymous scientific authors, begins by reminding its readers of some of the successful applications of science to war in the past: Haber's nitrogen process making it possible for Germany to survive for four years in the last war, Bergius' oil-from-coal process providing Germany in this war with a respectable fraction of her petrol needs, the success of aerodynamic research, the virtual abolition of typhoid and paratyphoid among armies in the field, the prompt countering of the magnetic mine by the de-gaussing girdle, and so on.

But the bulk of the volume is concerned with suggestions as to the ways in which science could render more aid in this war. It is recognized that in certain fields, such as blood transfusion, aerodynamics, or the physiology of high-speed flying, the scientific situation is excellent. But elsewhere it is not. A leading article in NATURE of June 22, p. 949, is quoted to show that the question of camouflage is being fumbled: the underlying scientific principles are not being applied, and the direction of the work is being entrusted to artists and Civil Servants instead of to the scientific experts. The new types of wounds, such as splinter-wounds, and recent discoveries in the physiology of growth and regeneration call for better co-ordination and larger scale work in relation to wound treatment. Endocrine research might be devoted to the problem of inducing more rapid growth in livestock. The large wastes in various crops which arise from our inefficient methods of seed-production could be markedly reduced by proper organization, once the underlying scientific principles are grasped. The utilization of miniature methods of radiography would enable every recruit for the services or for industry to be X-rayed as a simple matter of routine, so permitting the diagnosis of early tuberculosis, reducing wastage of man-power, and improving national health. In the building of factories, considerable waste of steel is taking place through a neglect of scientific principles of design and the frequent employment of spans much in excess of what is needed. In purely military affairs, it is claimed that a scientifically conducted survey of the anti-tank measures adopted in the Spanish War would have enabled us to prophesy the comparative uselessness of our anti-tank guns, and would long ago have indicated the lines along which successful weapons are to be found.

These are a few of the specific examples which the anonymous authors adduce. In other cases, what is lacking is not so much specific research or scientific application as a general scientific approach. This is well illustrated by the chapter on food. It was only after nine months of war that the scientific advisory committee on national food requirements was appointed (NATURE, June 8, p. 887). Policy up till then had been a compromise between tradition, specific scientific advice, the views of the National Farmers' Union, and various interests concerned with food production and food marketing. The agricultural advisory services and research institutes were scarcely used to advise on the ploughing-up scheme. A lead is still lacking as to the amount and type of fertilizers required for maximum production. Only half-hearted attempts have been made to ensure maximum human efficiency by seeing that everyone gets enough protective food substances (it is stated that a 'vitamin biscuit' giving adequate amounts of the ten most important vitamins and the three or four essential mineral salts could be provided daily for every man, woman and child at a cost much less than, for example, the pre-war sugar beet subsidy).

The man of science sees the problem as a two-fold one: first, to ensure a national diet adequate for full physiological health, and secondly, to save as much shipping space as possible by substituting home production for importation. There may, of course, be cases where economic foreign policy demands that certain imports be retained, where certain types of boats (for example, banana boats) cannot be converted to other uses, where to cut down drastically on certain foods (for example, meat) would be bad for morale; but these involve merely adjustments of the main principle. Once such a unified approach is agreed upon, sectional interests and traditional inertia must and can be overcome.

However, a still more general approach is possible. What is needed is the recognition that the world we live in is a technological world, and that success in it therefore depends primarily upon the utilization of scientific knowledge and of scientific method. This is just as true of war as of peace, of human affairs as of engineering or bacteriology. Scientific management is as necessary as, say, chemical warfare research. But the main need is the integration of all aspects of the war—strategy and tactics, supply and food, propaganda and morale—in a comprehensive scheme of scientific planning with proper facilities and proper co-ordination.

Traditionalism is one enemy of technical efficiency. Tradition may be extremely valuable: it becomes dangerous when the assertion is made that it *must* be valuable. Another enemy is the ignorance and sometimes mistrust of science still to be found in many important quarters—in business, farming, the Civil Service, among military authorities. This has expressed itself very frequently in the relegation of the man of science to an advisory role. He sits on an advisory committee, which gives answers to such questions as may be asked it. But the authorities are under no obligation to ask questions, and the result may be the partial or total sterilization of science in that field. In any event, as every research worker knows, half the battle in science consists in asking new questions which the non-scientist cannot be expected to think of.

The authors conclude that somehow means must be found for short-circuiting the present devious and dampening routes between science and the problems to be solved—or, in other words, between men of science and the men with difficulties to surmount. The authors have some hard things to say about the refusal of many men of science to look beyond their specialisms and face their social responsibilities. This conclusion can be generalized for other walks of life: "What must be realized is that the time has definitely passed when individual responsibility could be regarded as ending with the proper carrying out of traditional functions or administrative orders. Merely doing one's duty in a conscientious and blind way is not what the situation demands. Thought, ordered and organized thought, directed to speedy decisions, is the first requirement".

The publisher in his foreword informs us that "Science in War" was conceived, written, printed, and published in less than a month. This abbreviated gestation, more characteristic of a rodent than of a human being or a book, though very remarkable, has had certain unavoidable defects. The book betrays its composite authorship rather too obviously, and there are a number of misprints (of which "The Ministry of Poland", referred to on p. 13, is presumably one !). Nevertheless it is a valuable contribution, which should be widely read and, let us hope, acted upon. J. S. H.

MICRO-DIFFUSION IN CHEMICAL ANALYSIS

Micro-Diffusion Analysis and Volumetric Error
By Prof. Edward J. Conway. Pp. xiii+306. (London: Crosby Lockwood and Son, Ltd., 1939.) 25*s*. net.

THE development of new methods of chemical analysis brings often in its train the discovery of new facts and the opening up of new fields of investigation. This is particularly true of biochemistry, where the accurate estimation of small quantities of substances in biological material may be of fundamental importance. There can be little question that the rapid progress in biochemical achievement owes much to the invention of microchemical methods of analysis applicable to biological material.

Prof. Conway's admirable book describes the application of a relatively new technique, that of microdiffusion, in chemical analysis. The Conway unit, in which the microdiffusion principle of analysis is embodied, is now well known to biochemical workers, particularly for the estimation of ammonia. With this simple apparatus distillation and aeration are eliminated and the passage of ammonia takes place by diffusion from one chamber in which it is generated into another chamber in which it is absorbed. Details of the conditions controlling this diffusion so that an accurate estimate of the diffusible substance can be made, together with details of the apparatus employed, are fully described and explained in a most interesting section of Prof. Conway's book. The microdiffusion procedure has been found already to be of value in the estimation of the following substances: ammonia, total nitrogen, urea, adenylic acid and adenylpyrophosphate, adenosine, aliphatic amines, chloride, bromide, carbon dioxide, acetone and alcohol. Prof. Conway fully describes the application of his unit to the estimation of these substances in tissues and biological fluids. This impressive list of substances will doubtless be enlarged in the future as the principle of microdiffusion in analysis becomes more widely recognized and employed.

Micro-titrations involve the use of accurate volumetric apparatus, and a knowledge of the errors to be found in volumetric analysis is obviously essential for an appreciation of the limits of the accuracy obtained in such estimations. One third of Prof. Conway's book is devoted to a very complete and valuable treatment of the errors of volumetric titration, of the errors encountered in the use of pipettes and burettes and of the corrections which have to be applied for accuracy.

A chapter on the principles of colorimetry and spectrophotometry as used for micro-analytical work, and one on the micro-techniques of Kirk and of Linderström-Lang and Holter, are useful additions to the book.

This volume is of great value to all workers interested in microchemical technique. It is excellently produced and printed, with copious drawings, curves and references. Its only drawback is its relatively high price, which might put it out of the reach of many of the students for which it is intended. J. H. QUASTEL.

PROBABILITY AND RELATIVE FREQUENCY

Probability and Frequency

By Prof. H. C. Plummer. Pp. xi + 278. (London: Macmillan and Co., Ltd., 1940.) 15*s.* net.

THE approach to probability adopted in this book is conventional, but cautious. The two definitions, the one *a priori*, based on equally likely aspects of a system, the second *a posteriori*, based on relative frequency in repeated trials, are stated and criticized, the first being preferred, but with qualifications. In the first two long chapters sixty illustrative examples of the most varied kind, divided equally between discrete and continuous problems, are posed, solved and commented upon. The reader who has worked through these will have learned a great deal about cards, dice, the Problem of Points, the St. Petersburg Paradox, Laplace's Law of Succession, Buffon's needle and many ingenious and interesting problems in geometrical probability; he should indeed be able to attack almost any reasonable problem of the kind.

In the long chapter on the Theory of Errors the normal law is derived first by Herschel's considerations, then by other sets of postulates, the conclusion being that it is "an empirical rule which is supported by experience in general, but which in the last resort must be verified by the same test". The principle of Least Squares is derived from the assumptions of normal distribution of error, and maximum probability; the other derivation, by minimum variance of consistent linear estimate, is mentioned, but as of secondary importance. (The present reviewer cannot agree with this assignment, nor with the statement at the end of § 168, p. 162, that "the basis of probability" is abandoned in this second approach; and incidentally it is not necessary for its validity that the law of error should be symmetrical.) The treatment and notation follow classical tradition.

The statistical distributions in one variable treated in Chapter iv are those of Poisson, the Type A Series with the cubic correction term, and Pearson's system, introduced by way of the limiting case of the difference equation of the hypergeometric distribution. The point of view of curve-fitting is empirical. "The results have only to be justified by success."

The criterion of "success", Pearson's χ^2, nominally appears in Chapter v, devoted to correlation, including the normal correlation function in two and three variables, correlation ratio and contingency, but also containing derivations of the distributions of χ^2, of the estimate of variance, of Student's ratio and of the ratio of two mean squares, and finally of R. A. Fisher's distribution of r, with the hyperbolic tangent transformation to approximate normality. The inclusion of these distributions adds very considerably to the value of the book. Tables of $\log_{10}\Gamma(x)$ and of the normal probability integral (in the form in which the modulus of precision is the parameter) are appended.

The book is a welcome addition to the rather exiguous list of text-books in English on the subject. Lack of space is doubtless the cause of the omission of certain important topics, such as the theory of estimation of parameters in a probability function. In a few places more precise statements could have been made. For example (p. 250), in the matter of the χ^2 test with reduced degrees of freedom, it should be stressed that the relations used in fitting the curve should be *linear* in the class-frequency deviations. Again (p. 226), for r to be zero it is not necessary that one or other of the distributions of x and y should be symmetrical; their independence is sufficient. And lastly the reviewer, holding as he does that to keep an open mind is to assign no probability whatever, must demur to the suggestion (p. 3) that "ignorance may be an element conducing to equal likeliness". These, however, are mere *obiter dicta*; the book is at all times interesting, and punctuated with dry common sense. A. C. AITKEN.

PHYSICAL EDUCATION IN GREAT BRITAIN

By Sir George Newman, G.B.E., K.C.B.

THE debate in the House of Lords on July 12 on the subject of national physical training —introduced by Lord Samuel, discussed in an admirable expository speech by Lord Dawson of Penn, and answered on behalf of the Government by Lord Clifden—has again directed public attention to the urgency of a problem which was first officially raised by the Physical Deterioration Committee of 1904, so long as thirty-six years ago. It will be remembered that that Committee held a grand inquest on the physical condition of the English people, the greatest inquiry of its kind since the Royal Sanitary Commission of 1868: "The people perish for lack of knowledge." It thus set going the action of the State to remedy matters, and recommended the medical inspection and feeding of school children, with the hygiene and physical training of boys, girls and adolescents. Indeed it made fifty-three separate recommendations, some fifty of which have now been adopted or discharged. Their beneficial effects were recognized during the War of 1914–18 by the Ministry of National Service and its Galloway Report on the physical examination of recruits in 1917–18. Now the War recalls us once more to tackle the same old problem.

From the beginning we must be clear about this problem. It finds its source in the advance of medical science, and its solution in social organization and its wise administration. First, as to its science. When Harvey demonstrated the circulation of the blood in 1616, he opened the door to an intelligible understanding of the physiological mechanism of man's body and the purpose of the blood. We now know that "the blood is the life" because it carries food, oxygen and hormones to all parts of the body, and we know also that its circulation is regulated and controlled by the operations, central and peripheral, of the nervous and muscular systems. "Through the motion of the blood," said Harvey in his famous ninth chapter, "the various parts of the body are nourished, cherished, and quickened by the warmer, more perfect, alimentive blood, which discharging its functions quickens the whole body and is indeed the foundation of life and the source of all action." Thus the first purpose of bodily exercise, whether formal or informal, whether of voluntary or involuntary muscle, is the attainment and maintenance of the growth and strength of the body structure as a whole and of its several parts. Secondly, by physical exercise we increase and develop the physiological functioning and nervous regulation of the various organs of the body, to produce a single harmony and a constant balance.

We know by experience that the living body requires food, fresh air (oxygen), warmth, muscular exercise of all its parts, and periodic rest. This has been proved to be the way, and the only way, to health and wholeness; even to survival. The heart is a muscle, the blood vessels have muscular walls, breathing is controlled by muscles, and likewise the digestive system, and thus the body becomes the power-house as well as the muscular engine of living; if we are to live, all these functions must be kept in health and vigour, in tone, readiness and quality by full and continuous stimulation. Finally, exercise keeps the body and mind one single total unity. Though its primary purpose is physical, the culture of the material body and its harmony and control, it is a means of discipline of the mind and spirit of man, to make the body its obedient instrument. Banish the exercise of heart and body and you banish life.

The practice of a regimen of voluntary exercise led the Greeks to devise systems of exercise, followed long afterwards in our own day by Swedish, German, Czech and British methods and physical philosophies. It is a feature common to them all that their social objective was scarcely less than their physical. Their greater end was health and human development, something religious, political, defensive, national, educational. This is strange but true, both in a historical and philosophical sense. Their purpose, expanding beyond the physical realm, thus became infinitely larger than merely the making of athletes or gymnasts. It was to induce manliness, to make and discipline men, to obtain a ready and perfect obedience, as Plato taught, "mainly for the sake of the soul".

Such being the basic science of physical education, there grew up, as civilization advanced, an ever-widening social purpose in its application. It is instructive to note that such purpose became the primary objective of the official recommendations of the Committee of 1904 and of the Ministry of National Service in 1919. Both of them saw poor physique, prevalent disease and high mortality, and they advocated hygiene and physical exercise as preventives; they saw unnecessary industrial fatigue in the factories delaying and reducing output, and crying for relief; they saw an urgent necessity for healthier and stronger recruits; they saw a 'half-baked' academic system of education of mind separate from body—and they both found, unanimously, that in disciplined physical education conjoined with the practice of hygiene there was a sovereign remedy, a true method both of healing and of health. Both knew that this was the task and duty of statecraft, and to its application we must now turn.

Nothing in the nature of organized physical education existed prior to 1861, when the army authorities began the physical training of recruits. It was a wooden and rather perfunctory plan of 'setting-up' exercises with dumb-bells and rifles, later amended by an infiltration of Swedish exercise. In 1871, the Education Code (following the Education Act, 1870) introduced school drill, as a meagre and half-hearted recognition of the need for physical training, following the so-called 'model' of the Army. In 1907, when the Board of Education embarked upon the medical supervision of school children, the whole subject was fully and officially explored, and in 1909 a scientific and comprehensive syllabus of instruction was issued by the Board, and physical education became for the first time an essential and integral part of the elementary school curriculum. This has developed into a complete system, with physical training organizers and trained teachers, comprising every kind of exercise, games, dancing, swimming, etc., for the elementary, secondary, technical, continuation schools and evening classes. The effect became almost magical and swept joyously through England, and, in association with medical inspection, hygiene, open-air schools, and school meals has revolutionized the health and physique of the children and young people. A comparison of the physical condition of the school children to-day with that of thirty years ago is patent, arresting and obvious to everybody.

This then is the enduring foundation of national physical education. *But it does not yet continue after school days.* The extremely precious age-period of adolescence has, with two exceptions, been neglected. For the army, navy, and air forces an excellent professional physical training has been available, and for the growing boy and girl Baden-Powell's scout movement came to the rescue, a voluntary movement which has inspired and revitalized the education of youth. Those two exceptions have saved the situation, for they have exerted an indirect effect upon the health education of the nation beyond compute. Concurrently, there has been for a long time past an enormous expansion of voluntary associations for games and sports of all kinds. Thus we have in England (*a*) the physical education of all school children, (*b*) professional physical training for the national services, and (*c*) a vast congeries of voluntary and varied agencies of leisure-time physical training following the free will and predilection of the individual. That is the three-fold scope of the English position. *It is good, but not good enough.*

Compare it with the modern German system under the Third Reich and its limitations are apparent: it is not universal, not a compulsory imposition, not for all classes and conditions, not one vast national practice which changes and unifies the character, purpose and aim of a whole people. Yet though the German system has produced a remarkable generation of vigorous and purposive youth, the English people have no desire to imitate it. For its dangers exceed its merits owing to one grave and universal defect: it ignores the individual education, growth, capacity and development of the personality, it is mechanical and 'dragooning', it is subversive of individual freedom and suppressive of national liberty, it is misdirective in purpose and ideal, for it seems to be designed solely to invent and retain a machine-made man for military service, and thus it becomes soul-destroying.

What then should we do? There are three things to do forthwith. First, we must be vigilant to maintain and make absolutely efficient our school system of a broadly conceived and wisely administered system of physical education in every school area of Great Britain, even in these difficult days of evacuation and disturbance of school education. Every child in the country, rich and poor, should receive thorough training in the practice of health and physical exercise, at the hands of competent teachers. Secondly, this inestimable advantage should be carried on through adolescence, by means of some form of continuation school or otherwise. Thirdly, the voluntary movements in physical education should be warmly encouraged, organized and co-ordinated by one central body. Fortunately, such an organization already exists, and has abundantly justified itself—the Central Council of Recreative Physical Education (58 Victoria Street, London, S.W.1). This Council is fully representative of all forms of physical training, games and sport. It has done quite invaluable pioneer work in education and demonstration in all parts of the country. It should receive sufficient financial support from the State and the local authorities to make it a still more effective instrument. What the nation needs in this problem is not more inquiries, new bodies or departments, but more united effort, power and imagination to devise ways of co-operating and utilizing the existing means and agencies.

REINFORCED WHITE FLOUR

By Dr. T. Moran and Prof. J. C. Drummond

IN the House of Commons on July 18, the Parliamentary Secretary to the Ministry of Food announced that very shortly the white loaf would be fortified with a supplement of vitamin B_1 (aneurin) and a calcium salt. It is understood that the vitamin B_1 will add approximately 100 I.U. to the daily intake, whilst the addition of calcium will ensure that all classes of the population are receiving at least the daily requirement of approximately 0·60 gm. Both constituents will be introduced into the flour stream at the mill, where accurate control can easily be achieved. This decision will probably not satisfy the advocates of brown or wholemeal bread; but it is a compromise which is sound on nutritional grounds and inevitable from the practical point of view.

The present-day straight-run white flour (73 per cent extraction) has a B_1 content of 0·30 I.U. per gram against 0·75 and 1·3 for 85 per cent extraction and genuine (100 per cent) wholemeal, respectively. These are only average figures, since the amount in different wheats varies from about 0·6 I.U. to 3·3 I.U. per gram. Taking the average consumption at 60 oz. a week, white flour at present contributes approximately 80 I.U. a day; the new flour will increase the figure to 180 I.U.

Dietary surveys have established that the nation as a whole is not receiving sufficient B_1. The League of Nations Technical Commission on Nutrition gave the figure of 300 I.U. a day as the daily need of an adult male. There is now, however, considerable evidence to show that this figure is low and, excluding the particular case of pregnant women, the minimal requirement per weighted head of the population is 400–500 I.U. per day. An analysis of Sir John Orr's 1936 survey shows that the intake of 50 per cent of the population falls below this figure, whilst a more recent survey gives the average per head figure as approximately 300 I.U. per day. The proposed supplement to white flour should, therefore, greatly reduce B_1 deficiency. Furthermore, such a step is particularly important at the present time when the deficiency is likely to be aggravated because of the possible reduction in the consumption of meat and dairy produce.

The decision to increase the calcium content of bread is of particular interest because flour—either white or wholemeal—is not an important source of this mineral: on the basis of a requirement of 0·60 gm. per day, flour only contributes about 10 per cent of this amount. There is good evidence of calcium deficiency in many diets, and obviously flour is a convenient vehicle to make it good. The ratio of calcium to phosphorus in white or wholemeal flour is 1 : 6½–10 and is, therefore, not well suited to the needs of the animal body—which are best met by foods with a ratio of 1–2 : 1. This is an argument against the addition of calcium phosphates, although they would, in fact, tend to correct the balance. One possibility is calcium carbonate which, introduced at the rate of ½ lb. per sack (280 lb.) of flour, would raise the calcium intake of Orr's lowest income groups to roughly the minimal level. Incidentally, this quantity of calcium carbonate would have no adverse effect on the palatability or general quality of bread.

The introduction of the new white flour will undoubtedly stultify the controversy about white versus brown bread, since it is mainly in respect of B_1 that the white loaf has been open to attack. There is not the same evidence that we are deficient in vitamin E or the members of the B_2 complex, which are present in wholemeal flower, while, as regards the mineral constituents, the relative merits of the two flours are uncertain because of the higher phytic acid content of wholemeal flour. The practical objections to wholemeal bread, however, are, at the moment, overriding. The evidence is that the bulk of the people prefer white bread; it is certainly true that only 5–10 per cent of the bread sold is brown or wholemeal. Again, any increase in the extraction would reduce the amount of wheat offals available for feeding stuffs and, in particular, jeopardize our milk supplies. Finally, white flour keeps very much better than brown or wholemeal flour and need not be turned over so frequently. This is particularly important at the present time on account of the vast stocks of flour that are being stored as a war reserve. Nevertheless, Mr. Boothby made it clear that wholemeal bread will still be available to those who prefer it and at the same price as that for white bread.

The increased intake of B_1 should materially improve our general health. Beriberi is rare in Great Britain, but the effects of partial deficiency, including loss of appetite, physical vigour and disorders of the alimentary tract, the nervous system and cardiovascular system, must be widespread. It is always difficult to relate suboptimal health to the lack of a particular nutritional factor, but the recent direct experiments of Jolliffe in the United States are particularly striking. He gave a daily ration to five healthy subjects, containing only half the minimal dose of B_1, and found that, within five days, four of the subjects showed characteristic signs of B_1 deficiency, including fatigue and lassitude, anorexia, precordial pain, burning of the feet, muscle cramps and palpitation. The introduction of an increased amount of aneurin into the diet caused all these symptoms to disappear within three days.

So much for the nutritional aspect. As regards the appearance and palatability of the new bread, careful tests have shown that aneurin is absolutely inert and has no effect on the dough, the volume of the loaf or the crumb character of the bread. Furthermore, due to the acid *p*H of flour, approximately 5·4, the aneurin is quite stable and there is no loss during doughing or baking. The flour will, therefore, be indistinguishable in appearance and handling properties from the present-day flour.

The introduction of the small amount of aneurin necessary will present no difficulty. It will be first mixed with a suitable quantity of flour, and this concentrate will be added at the rate of 1 oz. per sack. Equipment is in existence for doing this, and tests have already been made showing that there will be no difficulty in obtaining uniform distribution of the aneurin throughout each sack and in the entire flour stream. Determination of the aneurin in the flour and bread is possible by the thiochrome test with an accuracy of at least 4 per cent.

The new loaf, which has been under consideration for some time past by the milling industry and the Ministry of Food, now has the support of the Scientific Food Committee under the chairmanship of Sir William Bragg. Viewed from the general aspect of the nation's food, it is a revolutionary advance, because it can only mean that, in the future, whilst the preferences of the public will always receive first consideration, steps will be taken to make good any nutritional deficiencies both in individual foodstuffs and in our diet as a whole. The new loaf, in fact, with its supplement of vitamin B_1 on one hand and calcium on the other, embodies this general policy. There will now be two outstanding examples of fortified foodstuffs, bread and margarine—incidentally, both of first importance in the food of the poor.

PLANT DISEASE IN RELATION TO THE PUBLIC*

BY PROF. W. BROWN, F.R.S.,

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

THE term 'plant disease' is used in somewhat different senses. As typical examples one would cite such troubles as rust, mildew, damping-off of seedlings, etc., in which the higher plant is attacked by a parasitic fungus or similar plant organism. The destruction of fruit blossom by a late frost or the failure of a crop from drought or malnutrition are not commonly looked upon as the effects of disease; but it is logical to extend the term to include such cases. This has been the practice in human pathology where, for example, a group of 'deficiency diseases' is well recognized. Similar troubles occur also in plants. One speaks, therefore, of the physiological as against the parasitic type of disease, a division which is convenient, though in practice it is not possible to draw a hard and fast line between them.

Again, it is customary to distinguish between diseases and pests; for example, rose mildew is a disease, rose aphis is a pest. It is usual to apply the term 'pest' when the parasite is an animal, but again there are exceptions. Thus one speaks of the eelworm disease of narcissus, though the causal agent is an animal. The line of demarcation is distinct in theory, but pests and diseases are often interlinked, as in many virus diseases of plants.

For the present purpose, the effect on the crop is the matter of chief interest, and this may be the same whatever the causal agent—whether it be fungus, bacterium, virus, insect, nematode, etc., or whether the cause be strictly physiological. The effect may be sudden, leading to death of the plant at a very early stage, even before germination; or the plant may flourish for a long time and then be crippled or destroyed as it reaches maturity; or finally the product of the plant may be attacked in storage. Again, according to the nature of the causal agent, the damage may be unavoidable, or it may be partially or completely eliminated by proper precautions or treatments. Such details are for the consideration of the technical expert; the public are concerned with the final result, namely, that for one reason or another there is a material reduction of the quantity or lowering of the quality of the particular product.

---

* From a Chadwick Public Lecture delivered on June 20.

Plant diseases occur in varying intensity from year to year and place to place and cause a general wastage of plant material. It is, however, when they occur in epidemic form that they excite the public interest. Such was the great Irish potato famine of 1845–47. In 1845 Ireland carried a population of more than 8¼ million, consisting mainly of peasants whose staple crop was the potato. There had been partial or local failures of this crop previous to 1845, but in this year appeared a new disease which blighted foliage and tubers. In the following year it came earlier and in severer form. Contemporary accounts speak of the suddenness of the outbreak and of the devastating effects over large areas. By 1847 the severity of the disease had somewhat abated, but distress and disorganization were now widespread. There was absolute starvation in certain districts and nearly half the population were in receipt of relief. An outstanding result of the epidemic was a wholesale emigration to Britain and America, so that the population of Ireland had fallen in 1853 to a little more than 6 million.

Other noteworthy examples are the coffee rust epidemic in Ceylon which ruined the coffee industry in that country and forced the planters to turn their attention to tea cultivation, and the many rust epidemics of wheat which have occurred on the continent of Europe and in North America.

The risk of a world-wide scarcity of important plant products, which may arise from disease in epidemic form, has been much reduced by the opening up of large new areas of production in the various continents, and by great improvements in methods of storage and transport. Within the past twenty years the problem has at times been rather the converse one, namely, the incubus of too much of certain important plant products. Thus one read of coffee beans being used as fuel in Brazil, of fields of cotton being ploughed under in the United States, and of British farmers being penalized if they planted more than a certain acreage of potatoes. It is curious to reflect that a widespread drought in North America, which led to an extremely low yield of cereal crops, was hailed by the commercial world as a blessing, as it tended to "right the statistical position". In such conditions the biological worker, who aims at devising methods for increasing the productivity of the earth, may wonder what his function may be. Perhaps he can fortify his mind by doubting the reality of those surpluses which weigh upon commerce, and by asking, for example, whether a surplus of wheat means that no person is underfed.

Attempts are often made to assess the losses in money value which follow from particular plant diseases, but it is doubtful if much significance can be attached to calculations of that sort; the relevant data are difficult to obtain and may be difficult to interpret. The conditions which govern the trade in the commodity have an important modifying effect, as the following examples will show.

A reduced yield of wheat in Great Britain, by whatever cause it is produced, has a very small effect on the world price of wheat. The supply of wheat to the British market is not materially reduced, since wheat is easily transported and in fact Britain depends to a large extent upon imported wheat. The consumer, therefore, is scarcely affected, whereas the British producer loses more or less in direct proportion to the shortage of his crop. Now contrast this with the effect of a shortage or a surplus of the potato crop. Britain is practically self-contained with respect to potatoes. If the crop is abundant, prices fall. There is little tendency to increased demand, as potatoes are among the cheapest of foodstuffs and fluctuations in the retail price have little effect upon the quantity consumed. When, however, as a result of drought or blight or wastage in store, the crop is insufficient to meet the year's requirements, the price rises in a remarkable manner. Thus in consecutive years it may vary from about £2 to £10 per ton, that is, from a price which gives no profit to the farmer to one which is very profitable. It is notorious that, under the conditions which prevail in Britain, the potato crop yields a profit to the grower only in years when disease (in the wide sense) is most prominent.

A curious illustration of the effect of disease on prices was seen on comparing the market prices of a number of vegetables at the beginning of March 1940 with the corresponding prices a year earlier. Apart from effects arising from the War, a substantial difference was that the severe frost in January and February of 1940 had destroyed practically all the green winter vegetables. Nevertheless, the rise in price of the latter was no more than about 50 per cent, whereas such vegetables as parsnips and carrots, which suffered to a much less extent, were quadrupled in price. Obviously there was a general change-over in demand from one type of vegetable to another, and the effect of the frost cannot, therefore, be assessed on the basis of the change in price of the products primarily affected.

In the three examples just given the effect upon price of reduced quantity, as caused by disease, has been considered. Another aspect of the question is illustrated by the relation of scab disease to the market value of apples. In its severest form this disease renders apples totally unmarketable, but more usually the effect is that the fruit bears superficial blemishes which detract somewhat from its appearance without in any way impairing its eating quality. Nevertheless, the presence of traces of scab brings about a remarkable lowering of the market value. This is partly because of popular fancy, but the main reason is that fruit, even if only lightly scabbed, cannot well be kept in storage—on account of water-loss through the scabbed areas—and must, therefore, be thrown upon the market during the period of glut. Scab-free fruit, on the other hand, can be held in storage for several months, and marketed in an orderly manner in a period of relative scarcity. The effect of disease in this case is primarily upon the quality of the product, which controls the quantity available at certain times of the year.

The aim of the research worker in plant diseases being to reduce the ravages so caused, it may now be asked—who is it that benefits by any advances which are made? From the national point of view, in times of peace but more especially in times of war, there can be no question as to the benefit. If a 50 per cent yield is by some technical advance converted into a 90 per cent one, then 50 acres are made to do the work which formerly required 90, and to that extent the effective productive area of the country is extended. From the consumer's point of view the benefit is also obvious, as increased supply leads in general to freer and wider consumption and to a rise in the standard of living. It is when we come to the producer that we meet with a mixed reaction. Producers are competitors, and it is undoubted that an advance in methods of dealing with plant disease may bring immediate loss to some of them. The more skilled or the more fortunately situated may lose some of their former advantages. Two examples will make the point clear.

The disease known as 'reversion' was for many years a limiting factor in the production of black currants. Effective methods of combating reversion are now known and put into practice, with the result that the cost of producing the crop has been reduced by nearly one-half. It is stated that whereas in the past certain growers—presumably those with special knowledge—made handsome profits, nowadays there are too many growers who possess the necessary information, so that profits have become much more ordinary. The benefit, as is usual, has come to the consumer in a cheapening of the fruit.

The second example relates to the potato industry. On account of the prevalence of certain virus diseases in the warmer parts of Great Britain, stocks of potatoes lose their productive capacity and require to be replaced by more vigorous planting material from the colder and wetter parts of the country: hence the seed-potato industry of Scotland and Ireland. It is obvious that if an effective economic method were devised whereby the cropping power of English seed potatoes could be maintained, the inevitable result would be the elimination of an established industry in Scotland and Ireland.

Examples of this sort could be multiplied. Plant disease is largely conditioned by differences in climate, soil, cultural methods, etc., and thus varies in importance from one district to another. While it is to the interest of the individual producer that the diseases from which his own crops suffer should be suppressed, it does not follow that the group of producers is equally interested. It is important to recognize this fact, especially in its relation to the initiation of research on plant disease. It may seem a plausible suggestion that the farming class should subsidize research, for the reason that it is their crops which are damaged by disease. This argument is in many cases fallacious, and it would be more correct to say that the initiative should rest with the central authority in its capacity of guardian of the general public.

Plant disease plays an important part in determining the location of various crops and the manner of their cultivation. Climate and soil may be the predominant factors, but these often operate through associated plant diseases. A striking example of this relationship is seen in the location of the seed-producing areas. These tend to develop in parts which have a low autumn rainfall. Seed-bearing plants are extremely liable to damage by fungi in wet weather, especially after the flower has faded, with the result that the yield is lessened, the seed is of poor germinative capacity and is liable to carry infection to the new crop. The location of the 'seed'-potato industry, already referred to, affords a second illustration, though here the favouring conditions are precisely the opposite, seed potatoes of high cropping quality being produced in the wetter, colder areas. The explanation of this apparent anomaly is simple. Loss of cropping power in potatoes is caused by a number of virus diseases which are transmitted by aphides. The latter are much less abundant where the climate is cold and wet, and therefore the tendency to dissemination of virus diseases is much reduced.

A further impact of plant disease upon agricultural trade is seen in the various restrictions which legislatures have imposed in the attempt to prevent or limit the spread of infective plant diseases. These operate between one country and another or even between different parts of the same country, and take the form of quarantine regulations, embargoes, systems of inspection and certification, etc. It is a controversial point how far such legislative interference achieves its primary object and how far it is liable to be abused for purely commercial purposes.

Advances in the practice of combating (in technical language 'controlling') plant diseases are necessarily slow. Even when the investigator has the good fortune to devise a promising method, it must be fully tested over a range of seasons, and in relation to the variety of cultural systems which prevail in practice. Years may be spent in perfecting details, and there may in fact be no finality in this respect. When the method has been elaborated and shown to be effective and economical, it will still fail to be accepted unless the operations involved are such that they can reasonably well be fitted into the routine of cultivation. Too often the 'control measures' freely suggested in plant pathological text-books fail in this respect—they are utterly impracticable. On the other hand the urgency of controlling certain plant diseases may be so great that the go-ahead grower is prepared to modify drastically his system of cultivation in such a way as to facilitate the application of methods of disease control. This may be a very lengthy process indeed, and may require a long continued co-operation of practical grower, plant breeder, plant pathologist, entomologist and other experts. The recent history of the apple-growing industry in England illustrates this type of development, and as the public has gained very notable benefits thereby, a sketch of the 'evolution' of production may suitably conclude this article.

The old-fashioned apple orchard was planted with 'standard' trees, widely spaced, intercropped at first with bush fruit, and as a rule finally laid down to grass. The trees were expected to grow to a large size and to come into production in 10–15 years. The large size of the fully grown trees made spraying difficult and pruning very laborious. Pests and diseases tended to become rampant; much of the fruit was tunnelled by insect larvæ and, if not prematurely shed, finally invaded by rotting fungi; scabbed apples were the rule; the growth of the tree became quite unregulated; and at the best the harvest was a mass of ill-assorted fruit, unattractive in appearance, which was in the main thrown upon the market immediately after being picked. Much of it never reached the market at all, and as far as the public was concerned, English apples were abundant for about two months in the autumn, after which they were seen no more.

Consider now the more modern method. The type of tree favoured is the dwarf. This is obtained by grafting on certain types of rootstock, and so thoroughly has the interaction of stock and scion been studied that it is now possible for the grower to select the combination which will in due course produce the tree of desired size on his particular soil. The dwarf tree being closely planted and coming into early bearing, the complications which follow in practice from undercropping with bush fruit are avoided; the trees are easily shaped and pruned; growth is regulated so as to admit a maximum of sunlight to the centre, thereby enhancing the colour of the fruit and affording a partial control of fungoid diseases; the trees are manured according to well-defined principles, with considerable effect on cropping power and fruit quality; spraying against insects and fungi is systematically carried out, the smallness of the trees making such treatment highly practicable; the crop if too heavy is suitably thinned and spaced; the trees being small and sturdy, damage to the fruit from autumn winds is reduced to a minimum. The final crop may not equal in quantity what was from time to time obtainable by the old methods, but the quality is much higher.

The improvement in method goes much farther. Fruit of the quality described is capable of being stored. Much physiological research has been devoted to solving the problems of storage diseases, and new methods have been devised. The final result, therefore, is that the produce of the modern orchard is marketed steadily over a period of many months. The progressive grower has benefited financially by the change, but the greatest benefit has come to the consuming public, which can now satisfy its appetite for English apples over eight months of the year instead of two months as formerly. Stated in another way, the essential difference is that a very high proportion of the apples from the modern orchard reaches the consumer, whereas much of the crop grown by the old method was merely wasted. For this meritorious advance the plant pathologist shares the credit with other technical workers, and it is along such co-operative lines that further progress is to be sought. Lest it should be assumed that the above rosy picture applies to all crops, it may be added that there is room for further advances. There are still many crops in which the proportion of waste is extraordinarily high, and it remains for the research worker of the future to point the way to a desirable improvement.

OBITUARIES

Sir Arthur Harden, F.R.S.

BIOCHEMISTS the world over will have heard with sincere regret of the death of Arthur Harden on June 17 in his seventy-fifth year. By his late colleagues at the Lister Institute and by a host of old pupils from many lands who learnt at his feet or at one time collaborated with him, his loss will be particularly felt, for Harden who, on his retirement in 1930, had completed thirty-three years of service as head of the Biochemical Department, was in himself an institution and a veritable tower of strength in the Lister community.

A pupil of Roscoe and a lecturer in chemistry at Owens College for nine years, Harden came in 1897 to London to take charge of the Chemical and Water Laboratory of the Lister Institute, then the British Institute of Preventive Medicine with its laboratories in Great Russell Street, in succession to Mr. Joseph Lunt, who had received the appointment of assistant in physics to the Astronomer-Royal at the Cape. The Institute was then young, financially very insecure, and struggling to justify its existence to a somewhat impatient generation unused as yet to the trained professional prepared to play his appropriate part in concerted attacks on basic problems of preventive medicine. Soon, however, the position was to change for the better, for in May 1898 the Institute was able to remove to the new buildings in Chelsea Gardens and in December of the same year, the Council of the Institute was happy to accept the munificent donation by the late Lord Iveagh to the Institute's funds.

Harden's training and research experience in chemistry at Manchester and at Erlangen had been, up to the time of his joining the Institute, on strictly orthodox and classical lines, and it was on this sound foundation that he was soon to build the high reputation he later enjoyed as a pioneer of biochemistry in Great Britain.

On his arrival in October 1897, Harden found the then director, Dr. Allan Macfadyen, actively engaged in the study of the fermentative activities of the *coli* group of organisms, and at Macfadyen's suggestion he embarked on an investigation of the breakdown products of glucose. One of Harden's earliest publications on this subject appeared in 1899 in a volume not now readily accessible (*Trans. Jenner Institute Prev. Med.*, Second Series, Macmillan and Co.) but it was a subject to which he often reverted in later years. His great knowledge and practical experience of bacterial enzymes and bacterial metabolism generally enabled him to survey this whole field in masterly fashion for the "System of Bacteriology" (1930).

Certain circumstances of the time, however, drew Harden inevitably to the problem of the chemistry of the yeast cell, which formed the chief preoccupation of his working life for some thirty years. In 1897 Buchner had demonstrated the fermentation of sugar by the pressed yeast juice, while the interest taken by certain members of the Council of the Lister Institute in industrial fermentation processes had led in 1899 to the establishment of a Hansen laboratory under the direction of Dr. G. Harris Morris. This laboratory was, a year later, merged in the general chemical laboratory directed by Harden. Further, the efforts of Macfadyen and Rowland to secure the juices of pathogenic bacteria by grinding at the temperature of liquid air, an elaborate plant being available for this purpose, represented at least cognate inquiries to those on which Harden and his first collaborators, Sydney Rowland and W. J. Young, embarked with yeast juice as the object of test.

Here is not the place to follow in detail the story of the discoveries made by Harden and his collaborators in the course of their many years study of the chemical processes involved in the fermentation of sugar by yeast juice. That study is truly classic, and its issues have not only illuminated our knowledge of the chemical processes within the yeast cell but have also provided clues to the chemical dynamics underlying such seemingly remote processes as muscular activity and ossification of bone. For his work on alcoholic fermentation Harden was in 1929 awarded the Nobel prize in chemistry, shared with von Euler.

The yeast cell has been a gold mine to many kinds of diggers, and not least to those immersed in vitamin studies. It is not surprising, therefore, that Harden towards the end of the War of 1914–18 entered the nutritional field for a time, and with his colleague Zilva contributed a series of valuable papers on the antiscorbutic and antineuritic vitamins and their occurrence in various foods and drinks, not excluding beer.

Harden's outside links and interests were numerous, but perhaps his services as editor-in-chief of the *Biochemical Journal* for twenty-five years from 1913 until 1938 deserve special mention; for the influence he was able to exert in this capacity on the development of biochemistry in Great Britain has been incalculable.

Many honours came to him; an honorary LL.D. from Manchester and from Liverpool, an honorary D.Sc. from Athens, the Davy Medal of the Royal Society awarded him in 1935 and the honour of knighthood in 1936. Until some nine months ago, Harden continued to visit the Institute every day from his home in Bourne End and his interest in all the activities of the Institute never flagged. At his death he had been for nine years a valued member of the governing body of the Institute. A widower for twelve years, Sir Arthur leaves no family. To his sisters we would extend our sincere sympathy.

J. C. G. LEDINGHAM.

Mr. E. R. Gunther

It is barely two months since NATURE regretted the passing of Dr. R. T. Gunther; now comes the untimely death of his eldest son, Eustace Rolfe Gunther, at the age of thirty-seven, accidentally shot while on active service. This tragic event robs oceanography of one of the most virile of its younger workers. Educated at Winchester and Caius College, Cambridge, he was appointed as zoologist in 1924 to be one of the original members of the scientific staff of the Discovery Committee set up by the Colonial Office to investigate the resources of the antarctic seas, particularly in regard to the factors, biological and physical, governing the great whale fisheries of those waters.

It was my privilege to be closely associated with Gunther on the R.R.S. *Discovery* on her voyage of 1925–27, on the smaller ship R.R.S. *William Scoresby*, and afterwards in the joint authorship of an extensive report upon the ecology of the antarctic plankton. He was a man of sterling qualities. Working with him day and night, often under the difficult conditions presented by the Southern Ocean, one was continually impressed by his deep sense of duty, his devotion to his work, and his tireless energy. His enthusiasm was always combined with a scrupulous regard for accuracy: both in the field and the working-up of data. After working at the nets and water-bottles for thirty-six hours on end, except for odd moments snatched for hurried meals, it was only the fear of being inaccurate in the readings and recordings, not fatigue itself, which persuaded him to rest. He had a love of the sea and the open life; he was a real deep-water oceanographer, with the determination to bring back results.

In 1931 on the R.R.S. *William Scoresby*, Gunther led a highly successful expedition to investigate the Peru Coastal Current (sometimes called Humboldt's Current) and published in 1936 a comprehensive report on its physical, chemical and biological aspects. Later he again visited the Antarctic on a whale-marking expedition to study migrations, and made valuable observations on the swimming and breathing habits of whales (a paper now in the press). Much of his time before the War was spent in working on the material collected during a trawling survey, partly carried out under his direction, on the extensive banks lying between the Falkland Islands and South America. It is to be hoped that all the work he put into this will eventually be published.

In addition to his wide interests in zoology and oceanography, Gunther was always delighted to record any unusual natural phenomenon; his recent letter in NATURE on the ice storm in Wiltshire is an example of this. Colour and scenery were a great joy to him, and he did splendid water-colour drawings, both sea and landscape, as well as accurate colour studies of marine animals. Many will treasure his privately printed "Notes and Sketches made during two years on the Discovery Expedition".

It was characteristic of Gunther's capacity for work that his long leave after the 1925–27 expedition should have been spent in the Department of Biochemistry at Cambridge, undertaking researches on the fatty and vitamin content of plankton (published in collaboration with G. Collin, J. C. Drummond and T. P. Hilditch). His published work, while extensive, is no real measure of his industry. He was always being attracted by side branches which he felt it his duty to explore, and only when he had carried them a long way did he realize he was being taken too far from the main issue; reluctantly they were put on one side for some later available time—alas, now no more.

In 1937, distressed by Great Britain's unpreparedness for war, Gunther joined the territorials as a sapper and was commissioned a year later. On inquiry about the best use a man of his training might be, he was advised to enter the searchlight service, and his keen powers of observation were of particular use in training spotters. He was born on September 20, 1902. In 1929 he married Dr. Mavis Carr and leaves a son and two daughters. He was essentially happy in his work and family life, and was devoted to both. He has been a worthy upholder of the tradition set by his father, his grandfather, Dr. A. G. L. G. Gunther, F.R.S., and his great-uncle, Prof. W. C. McIntosh, F.R.S.

A. C. HARDY.

Dr. Wilhelm Stekel

DR. WILHELM STEKEL, the well-known psychoanalyst of Vienna, who died in London on June 27, was born at Bojan in Bukowina on March 18, 1868. He received his medical education in Vienna, where he was one of Krafft-Ebing's pupils, and qualified in 1893. After some years general practice he devoted himself entirely to neurology and psychiatry. He was one of the first medical men to be interested in psychoanalysis, and from 1896 until 1912 when, like Adler, Breuer and Jung, he assumed his independence, he was one of Freud's chief supporters. He was a very prolific writer. His principal works, which were all translated into English, are "The Beloved Ego" (1921), "Psychoanalysis and Suggestion Therapy" (1923), "Peculiarities of Behaviour" (1924), "Disorders of the Instincts and Emotions" (1929–1930), and "The Homosexual Neurosis" (1933). From 1910 until 1913 he was co-editor with Freud and Adler of the *Zeitschrift für Psychoanalyse*, and in 1924 became editor of *Fortschritte der Sexualwissenschaft und Psychoanalyse.*

WE regret to announce the following deaths:

Prof. J. G. Dusser de Barenne, Sterling professor of physiology in Yale University, on June 9, aged fifty-five.

Mr. C. Rawson, head chemist of the British Cotton and Wool Dyers' Association during 1917–20, aged eighty-one.

Prof. D. Riesman, professor of the history of medicine in the University of Pennsylvania, on June 3, aged seventy-three.

NEWS AND VIEWS

Ideals of Democracy

MR. ROOSEVELT'S broadcast, on accepting the nomination of the Democratic Convention for election to a third term of office as president of the United States of America, was inspiring in its note of lofty and patriotic self-sacrifice, no less than in its determination to maintain unswervingly in foreign policy the sympathy and moral and material support of all free peoples resisting the aggression, which has "wiped out ancient liberty-loving, peace-pursuing countries". Mr. Roosevelt contrasted the totalitarian States—"a relapse into ancient history"—with the democracy which can hold the votes of "the common people . . . only when it adequately respects their dignity by so ordering society to assure to the masses of men and women reasonable security and hope for themselves and their children". He went on to say that the democracies, both that in the United States and those still unconquered, "would never willingly descend to any form of that so-called security of efficiency which calls for the abandonment of other securities more vital to the dignity of man". Point is added to the clear-cut contrast by recent German propaganda culminating in the speech of Herr Hitler in the Reichstag on July 19. From these emerge a picture of Europe in the peace of the Chancellor's professed desire in which the non-Germanic peoples are the helots of a conquering caste—a reversion to the tribal domination of the Germanic migrations and invasions, which is the cardinal fact in Hitler's view of European racial and national history. It is well that he recognized that this conception of a European policy is so far incompatible with the ideals of democracy as to make inevitable the complete and final destruction of one or other of the two antagonistic systems.

Re-organization

WHILE it has been stated with every shade of emphasis and in constant reiteration that the democracies fight for freedom and justice, the need has been felt to counter German propaganda by a more concrete expression of the manner in which these ideals will be given effect in a post-War world. Although for the moment the immediate future is alone the matter of vital concern, yet science can afford, and indeed must, take a longer view even at this critical moment. The mistakes of the period immediately after the War of 1914–18, which sought to re-create a pre-War society that had for ever passed away, must not be repeated. The problems which will have to be solved after the present War must be approached with a complete change of heart from that of the vanished pre-War period. Narrow concepts of national self-sufficiency in political and economic relations will perforce have been dissipated. In their place the ideal for which we must strive with a burning enthusiasm more potent than the fanaticism to which Hitler attributes his present successes, is not merely our continued existence as a people. We must be prepared to sacrifice our all in the cause of the right of every individual man and woman to participate fully and freely in the duties no less than in the privileges of a world order based on mutual help and trust and not on force, a world in which the concept of the State has broadened into that of an instrument of the well-being of the individual citizen and not an overriding end in itself.

Man's Passion for Freedom

GENERAL SMUTS in his well-considered and judicial broadcast from South Africa on July 21, drew a favourable augury for the outcome of the coming attack on Great Britain from the indomitable spirit and unfailing courage of Allied troops in the withdrawal from Dunkirk. Against such a rock the waves of attack will beat in vain. It is, however, the spirit which informed the broadcast by Lord Halifax on July 22 which will bring victory—"the unconquerable passion of man for freedom". Hitler's policy he denounced as the gospel of hate, the policy of brute force, his message to mankind the enthralment of the human spirit under ruthless tyranny. It is perhaps permissible to suggest here that the fanaticism of Germany's irruption over the peoples of Western Europe admits a second comparison with 'ancient' history—the great fanatical spread of Islam. Then in east and west, in Spain and in Palestine, it fell to the peoples organized under the banner of Christianity to turn back the tide of invasion of an alien faith. The present war also is a struggle of the *spirit* of Christianity against the brutal force of paganism. As Lord Halifax said, "We must march together in this crusade for Christianity. We and our great Dominions oversea stand, and shall continue to stand, four-square against the forces of evil".

Advisory Research Council of the Chemical Society

THE Advisory Research Council of the Chemical Society (A.R.C.C.S.) still finds itself unable to suggest work of national importance to all of the large number of chemists who have volunteered their services, although more than a hundred topics have already been allocated. Hence it would be appreciated if research committees under Government auspices could make known to the Council the existence of chemical problems just below the level of priority which justifies the expenditure of public funds in the attempt to find a solution. There is in particular a dearth of worth-while problems of a physico-chemical nature.

At its last meeting the A.R.C.C.S. decided to interpret its functions in an elastic manner, and it is now prepared to organize the preparation, in laboratories of universities and technical colleges, of fine chemicals required for any purpose by Government departments, institutions or services or even for approved research purposes in other universities. It is a *sine qua non* that such substances are not available commercially and that the manufacturers of fine chemicals are unable, or do not find it convenient, to meet the need. The arrangement proposed is that the substances shall be made and supplied on a cost price basis, and it is understood that purchases made in this way will require no special Treasury sanction, being in fact acquisitions to stores. The secretary of the Advisory Research Council is Mr. S. E. Carr, Chemical Society, Burlington House, Piccadilly, London, W.1.

Registration of Chemists

COMPULSORY registration on the Central Register of the Ministry of Labour, which was applied last week to engineers, has now been extended to chemists, physicists, and quantity surveyors. The order referred to all possessing a science degree of a university of the British Empire including chemistry or physics and, in certain circumstances, those who passed the corresponding intermediate examination, or have similar standing in these subjects; also to those who have received training as quantity surveyors. These registrations will supplement the names of those already voluntarily on the Central Register.

Physical Problems in Industry

IN order to assist professional men who in the present emergency find themselves presented with technical problems in applied physics of which they do not happen to have had previous first-hand experience, it has been decided to extend the facilities of the Institute of Physics' panel of consultants. Through this medium inquirers are put into touch with those physicists most likely to be able to offer immediate practical suggestions in any particular case. In the first instance the contact is quite informal; subsequent arrangements are a matter for private agreement between those concerned. The subjects which can be dealt with cover all branches of physics, both pure and applied, including, for example, physical measurements and testing, the design and supply of scientific instruments for special purposes, and the control of processes by physical means.

By acting as a clearing house in this way and supplementing existing official and unofficial organizations, it is hoped to help in the national effort by directing attention to existing solutions of difficulties which, while appearing to be new problems, are often already well-known in other fields. A typical example will serve to illustrate this point. A recent inquiry related to possible means of measuring the flow of certain animal secretions having complex physical properties, which prevented the use of more usual methods. It happens that certain printing inks have somewhat similar properties, and an informal introduction to a physicist in that industry has proved of great assistance. Inquiries about this scheme should be addressed to the Secretary of the Institute of Physics at the University, Reading.

The B.P. Standard for Ipecacuanha

FURTHER modifications in monographs of the British Pharmacopœia have been effected by way of notice in the *Gazette* of July 5. The chief one is an alteration in the standard for the alkaloidal content of ipecacuanha. The direction in the B.P. 1932 requires the root to contain not less than 2 per cent of the total alkaloids of ipecacuanha, calculated as emetine, of which not less than two thirds consists of non-phenolic alkaloids, calculated as emetine; the change now made is the substitution of "three fifths" for "two thirds". Although the reduction in the standard is but slight, it will have a marked effect upon the availability of a drug which is regarded by the medical profession as an extremely important one, whether prescribed in the form of Galenical preparations, or as its alkaloid emetine, which is a specific in tropical dysentery. The 1932 test excluded from official recognition large importations of the root from Bahia and Minas Geraes, eastern States of Brazil, and virtually restricted the source of the standard drug to the western State of Matto Grosso. With the requirement as to the alkaloidal content reduced by a fifteenth, a substantial proportion of the shipments from the eastern States of Brazil will now conform to the B.P. standard. Thus the security of ipecacuanha root will be relieved and a reduction in the cost may be expected.

Air Raid Precautions

FOLLOWING the issue of the popular pamphlet "Your Home as an Air Raid Shelter", of which more than 700,000 copies have been sold, the Ministry of Home Security has now issued a second pamphlet called "Air Raids: What You Must Know: What You Must Do". This pamphlet is a complete 'potted' A.R.P. course for the general public. It tells the ordinary man and woman everything he can need to know for the protection of himself and his family in air raids, and to enable him to help his neighbours. It deals with such subjects as protection against bombs, behaviour during and after a raid, how to deal with incendiary bombs and war gases, and contains a simple first aid course. It tells the householder all about the warning system, how to make repairs to his house after a raid, and contains a wealth of practical information on all these subjects. The book is fully illustrated with photographs and diagrams. It can be obtained through any newsagent, price 3*d*., or price 4*d*., including postage, from the Stationery Office, York House, Kingsway, London, W.C.2. The pamphlet will be invaluable to members of factory and other A.R.P. squads.

Utilization of Aliens in National Work

SIR JOHN ANDERSON, Home Secretary, in a written answer to a question in the House of Commons on July 18, stated: "I have already given instructions to the police which I hope will prevent the internment of specialists or 'key' workers engaged in connexion with Government contracts or essential export trade. If in any individual case such a person should nevertheless be interned, it is open to his firm to make representations to the appropriate Government Department, and I am always ready to consider the question of releasing any internee who is certified to me by a Government Department as willing and able to render services of importance to the community."

Czech Culture under German Rule

DR. BENEŠ has written a restrained but authenticated account of some of the Nazi crimes in a pamphlet (London: Allen and Unwin. 6*d.*) which has just appeared. It was the pride of the Czech nation that its culture, bound by numerous traditional ties with Britain and the West, was acknowledged by the whole civilized world. Now, after more than a year of German occupation, relics alone remain. The Nazis have attacked all sections of cultural life in an attempt to destroy the fundamentals of Czech national ideals. Besides the universities and colleges, many schools are closed and modern educational buildings used as barracks, so that the education of Czech children is impossible. The dictum of the Nazi commissioners is that "for the Czechs as an *Arbeitervolk* elementary schools are sufficient". These serve for mass Germanization. School books have been "revised", and new ones with Nazi theories are systematically imposed upon the nation.

Meanwhile, twenty thousand students have been driven from their lecture rooms, and those employers who tried to alleviate their lot by giving them employment have been punished. Scientific equipment has been destroyed, valuable libraries wrecked and books and volumes of scientific journals burned or at best carried off to Germany. Results of years of research by Czech professors lie as rubbish on the floors of the lecture rooms and laboratories. The professors (some hundreds) and their assistants (about a thousand) were not allowed to take even their private possessions and note-books from their rooms; many have been sent to concentration camps and others given minor duties in administrative offices for which they were not fitted. The pamphlet merits the attention of learned men throughout the world and should arouse them to the danger now facing civilization.

Seasonal Mortality in England and the United States

SEASONAL variation of mortality has long been a fact of common knowledge, and its cause the subject of speculation. The maximum invariably falls in the first quarter of the year and the minimum in the third quarter. The difference between the two quarters is considerable; in 1931–35 the maximum was 60 per cent greater than the minimum. Is there any way, it may be asked, of reducing this difference, or is the winter excess due to causes of death over which at present we have little means of control? A comparison of the mortality figures of England and Wales with those of the United States shows that the winter peak is higher in the former, although in summer they fall to a lower point than the United States figures.

This seasonal difference of mortality in the two countries has been the subject of a detailed statistical study by Dr. Lewis-Faning (Medical Research Council, Spec. Rep. Series, No. 239. H.M. Stationery Office, 1940. 1*s.* net). He reaches the conclusion that the winter disadvantage and the summer advantage of Great Britain are not due to climatic factors only, but are both also dependent, at least in part, on factors of mortality preventable in some degree. Thus, the main contributors to the British unfavourable winter balance are influenza, respiratory tuberculosis, bronchitis and pneumonia, and it has long been held that the last-named is at least partially preventable. The two most important contributors to our summer advantage are diseases of the heart and deaths from violence. The former shows a large decline in summer in both countries, the latter reveals no decided seasonal variation in Great Britain but a large summer rise in the United States. The relatively high rate of mortality from this cause in the United States is clearly one that may be open to attack.

Cambridge University Botanic Garden

BOTANICAL gardens contribute living interest to the teaching of plant science, and it is significant that their development began in the earliest days of the study of botany. The University of Cambridge was not one of the first bodies to recognize the value of providing living plants for study, but it had some early associations with botanical science. Mr. F. G. Preston has published an interesting paper on the history of the gardens now under his charge (*J. Roy. Hort. Soc.*, 65, Pt. 6, June 1940). The famous Gerard attempted to establish a botanical garden at Cambridge in 1588, but without success. John Ray studied the Cambridgeshire flora, and later handed his mantle to the University's professor of botany, John Martyn, who extended the floral studies to other counties, and lived to see the first botanic garden at his University. In 1762, Dr. Walker, vice-master of Trinity College, obtained about five acres of land, on the advice of his friend, Philip Miller of Chelsea. The garden remained in poor condition until 1831, when Prof. Henslow was successful in obtaining the present site, and transferred the plants to their new surroundings. The names of Babbington, Lynch, Marshall Ward and Sir Albert Seward show to what extent the directors of the garden have contributed to the development of modern science, and in more recent times W. Bateson and Prof. R. C. Punnett have worked there. Development after the War of 1914–18 was along the lines of closer contact with the teaching of botany, and was associated particularly with the names of Reginald Cory and Humphrey Gilbert-Carter.

Accessions to the Fitzwilliam Museum, Cambridge

THE annual report of the Fitzwilliam Museum, Cambridge, for the year ending December 31, 1939, includes in a considerable list of accessions in the period a number of no little archæological interest and importance. Among these a bequest of an Egyptian bronze cat of the Twenty-sixth Dynasty by the late Claude G. Montefiore is said to be "the best of the type in the department". A steatite figure of Amen-ra and a hæmatite amulet of Ta-urt given by the director (Mr. L. G. C. Clarke) were the only further additions to the Egyptian antiquities apart from a valuable collection of choice specimens given by Mr. G. D. Hornblower. Mr. Hornblower was also the donor of two Chinese paintings on silk, a makimono and a sketch-book by Hokusai, another Japanese sketch-book, two Persian miniatures and a Coptic iron cross.

The Oriental Department also received some notable examples of Chinese ceramic art made specially for export, among these a porcelain bowl made for the Siamese market, given by Prof. Ellis H. Minns, of Pembroke College, and from the Hon. Lady Darwin another porcelain bowl which had been made for the European market, while an unusual punch bowl, intended for the same destination, was bequeathed by the late Lieut.-Colonel K. Dingwall. A Kutahia cup was a donation from Prof. Percy E. Newberry. In the Greek and Roman Department the most important acquisition was a fine south Italian bronze cinerary urn of the late sixth century B.C., purchased at the W. R. Hearst sale out of the Greek Antiquities Fund. Miss Winifred Lamb, honorary keeper of the Department, presented a Falisean skyphos of the fifth or fourth century B.C.

British Museum Library Extension

THE 'Iron Library' extension, which is now being completed at the British Museum, London, by H.M. Office of Works, is an interesting development in the introduction of welded steel work. The present structure is in the nature of an innovation, as it is the first example of an all-welded structural frame to be adopted by the Office of Works. The main factors influencing this decision were the greater neatness of the welded joint and the saving in headroom which it permits. It was designed to augment the bookshelf capacity of the Library. The extension occupies the north-east quadrant of the rectangular plot surrounding the historic Circular Reading Room and replaces a part of the existing structure of wrought iron and timber. In *Electric Welding* of May 1940, published quarterly by the Quasi-Arc Co., Ltd., of Bilston, Staffs., an instructive technical description, with photographs, is given of the building during the process of construction. Messrs. Dorman Long and Co., Ltd., are the constructors for the structural steel-work. They prepared and rolled the special sections; more than 500 tons of steel-work were necessary. Each welded joint was made in three runs from a No. 10 gauge electrode. The total number of welds in the structure exceeds 60,000. The welding has been carried out with a maximum of ten operators, who between them have used about 47,000 quasi-arc electrodes. The necessary welding current was drawn from quasi-arc Diesel, petrol and transformer units.

Meteorology in Southern Rhodesia

THE meteorological report for Southern Rhodesia for the year ended June 30, 1939, by R. A. Jubb, acting chief meteorologist, is dated January 1940, but follows the general lines of those of pre-War years. Seasonal forecasts of rainfall of the type made by Sir Gilbert Walker, based on past departures from normal of meteorological elements in selected action centres in other parts of the world, were continued, and were very successful in this year. The average rainfall over Southern Rhodesia during those months that correspond roughly with the winter of 1938–39 in the northern hemisphere, that is, Southern Rhodesia's summer rainfall of 1938–39, was forecast as 11·8 in. above normal; actually it proved to be 12·2 in. above normal. This was the third year in succession during which the method was strikingly successful, and it is easy to believe that, as stated in the report, the forecasts are being found to be of practical value; there appears to be no sign that the correlation coefficients on which the forecasts are based are becoming smaller, as is sometimes the case after a considerable number of years of high correlation, for the least successful forecasting period of three years ended four years earlier. In Southern Rhodesia rain is of paramount interest, and it is satisfactory to note that whereas thirteen observing stations closed down, the number of new stations was forty-one.

Map of the Karakoram

A NEW map of the Karakoram has been published by the Royal Geographical Society (7*s*. 6*d*. or R. 5). Produced under the direction of Prof. K. Mason, it incorporates all published results of exploratory work up to Mr. E. Shipton's expedition of 1937. The scale is 1 to 750,000 and the size of the sheet is about twenty by twenty-three inches. The great altitude range from about 3,000 ft. to 28,000 ft. presented a difficult problem in representing relief. The layer colour system had to be abandoned. The contours in a region of such high relief are too close and the tint of the layer merged into the colour of the contour line. Moreover a satisfactory scheme of colour could not be found. Hill slopes are shaded with brown and purple on a general ground tint of yellow and generally the shading is cast from the north-west, but the direction varies slightly to suit the slope of the ground. Blue shading is used for snow and glaciers are white. Valleys have a layer tint of greyish-green. There are altogether eight colours and the map is a most effective piece of work. Heights are given in feet and the names employed are those decided on by the Karakoram Conference of 1937 and approved by the Surveyor-General of India.

Metal Water-Jet Pump

ALTHOUGH metal filter-pumps have been in common use for some time, the majority were imported. A new model developed and produced in Great Britain is now available. Metal filter-pumps are unbreakable and easily cleaned. In addition, the jet of the new model has been re-designed so that a high pumping speed can be reached even with pressures as low as 15 lb. in the water supply. Under suitable conditions, pressures of 15 mm. or less of mercury are reached. The new pump should therefore prove of great service in general laboratory work involving distillations, filtrations or aerations and in hospital and surgical work. The pump and further details can be obtained from Messrs. W. Edwards and Co., Ltd., Southwell Road, London, S.E.5.

Physic and Literature

UNDER the title of "Books about the Doctor in Physick and Literature", Schuman's of 738 Fifth Avenue, New York, have published an annotated spring catalogue consisting of five parts devoted respectively to medicine in literature, medical biography, history of medicine, medical portraits and Beaumont lectures. The first part, which will probably appeal to the largest number of readers, contains a long list of *belles lettres* which have reference to medicine, including in alphabetical order Aristotle's masterpiece, Balzac's "Médecin de Campagne", Sir Thomas Browne's "Urn Burial", Burton's "Anatomy of Melancholy", Casanova's "Mémoires", Defoe's "Journal of the Plague Year", Pepys's "Diary", plays of Shakespeare, and Voltaire's "Candide". The relation of medicine to art is represented by Leonardo da Vinci's drawings and the works of Eugen Holländer. The works on medical biography include those of Bland-Sutton, Jerome Cardan, Harvey Cushing, Sir Henry Holland, Edward Jenner, William MacMichael and Thomas Young. Under the heading of medical history we find works by Allbutt on Greek medicine in Rome, Donald Campbell and Leclerc on Arabian medicine, W. G. Black on folk-medicine, Sir Michael Foster on the "History of Physiology during the Sixteenth to Eighteenth Centuries", August Hirsch on "Geographical and Historical Pathology", Osler on the "Evolution of Modern Medicine", J. F. Payne on "English Medicine in the Anglo-Saxon Times", and histories of medicine by Max Neuburger and Sudhoff.

Earthquake in Tibet

ON July 15 an earthquake of considerable severity accompanied by floods was reported in *The Times* to have caused havoc in the Chumbi Valley in southern Tibet. Villages from Yatung southwards suffered considerable damage, and the telegraph line from Yatung to India over a distance of six miles has been destroyed. All the bridges over the Amachu River have been demolished and, in all, two hundred people are believed to have perished. The epicentre appears to have been near lat. 27·5° N., long. 89° E., which is a little to the south of the epicentre of the strong earthquake of January 3, 1935, and to the south-west of that of January 7, 1937.

Earth Tremors in Great Britain

ON Sunday, July 14, at about 11.59 p.m. B.S.T. a slight earth tremor was felt in Birmingham, Coventry and Leicester. No damage was done. The epicentre was probably just to the north of Coventry. Earth tremors appear to be slightly more frequent in an area somewhat to the north of Leicester, that is, nearer to Nottingham, where one was experienced on May 3, 1935, though one was felt at Birmingham on October 23, 1924. On July 16 at about 5.35 p.m. B.S.T. an earth tremor lasting several seconds was felt very strongly in the Denny district of Stirlingshire and for some miles around. In the epicentral area, a man is reported to have been thrown from his chair. The shock threw crockery from shelves and moved chairs and desks in Glasgow offices; it was felt more strongly at the top of high buildings than in the street below. No serious damage has been reported. Slight earth tremors are very occasionally felt in this district, though the area most affected by earth tremors in Scotland is near Comrie in Perthshire, where the British Association has shock recorders in action. Both the recent Coventry and Denny tremors were probably caused by slipping along local fault systems.

The Night Sky in August

NEW moon occurs on August 3 at 20h. and full moon on August 17 at 23h. U.T. The moon is in conjunction with Mercury on August 2, with Saturn and Jupiter on August 24, and with Venus on August 29. Jupiter and Saturn rise after 22½h. at the beginning of the month and shortly after 21h. at the end, the two planets remaining within 1½° of each other. Although conjunction between them occurs on August 15, their closest approach (1·2°) is on August 7. Venus is the brilliant morning star, at greatest brilliancy on August 2, when it rises shortly before 1h. 45m. U.T. At the time of conjunction with the moon on August 29, it may be looked for in daylight north of the moon. A telescopic view of the planet will show it to be crescent-shaped throughout the month. Mercury, an elusive object at most times, should be easily seen in the east before sunrise, especially on August 10 when it reaches its greatest elongation (19° west). On August 10–12, the Perseid meteors reach their maximum frequency. Their radiant point moves from Andromeda to Camelopardus. The Milky Way and its associated constellations, rich in interesting objects for telescopic or binocular study, is well placed near the meridian after dark, especially towards the end of August, when the moon does not rise until the early morning.

Announcements

DR. WILLIAM W. WATSON has been appointed professor of physics in Yale University, in succession to Prof. John Zeleny, who retires this year.

THE degree of D.Sc. has been awarded by the Queen's University, Belfast, to R. C. Pink (chemistry) and C. T. Ingold (botany).

THE National Council for Mental Hygiene, 76 and 77 Chandos House, Palmer Street, London, S.W.1, has arranged for a conference to be held on July 30 at the British Medical Association House, Tavistock Square, W.C.1, to discuss psychological problems arising out of war conditions as they affect the teacher.

THE first volume in Braille dealing with botany has been prepared from a series of broadcasts on "Botany for the Amateur" made in the United States by Miss Jesse Fiske, State seed analyst of the New Jersey Experimental Station, New Brunswick.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Influence of Substitution on Organic Bond Strength

ATTEMPTS to establish the strength of organic bonds by studying the rate of decomposition of gaseous compounds have been made with success by F. O. Rice[1], but no systematic information on the influence of substitution on bond strength has been obtained. The problem was approached by R. A. Ogg[2] by a study of the breaking of the carbon – iodine bond in various compounds, and the present results were obtained in pursuing the same line by a new method. The vapour of the iodides at low pressure (0·01 mm.) and diluted with a carrier gas (6 mm. nitrogen or hydrogen) was passed through a tube maintained at 300–500° C., and the products were condensed and analysed for iodine and hydrogen iodide.

The assumption from which we started, that the rate-determining process is the unimolecular disruption of the CI bond, was confirmed for ethyl iodide by varying the experimental conditions; in the other cases, however, it could only be shown that the rate of bond breaking was the main factor. Nevertheless, the large variation in the rates of decomposition (10,000 fold at 430°) justifies a comparison of C – I bond strength from the relative decomposition rates. The bond energies tabulated below were calculated from the approximate relationship

$$\log k = -Q/RT + 13,$$

using the values of k for the lowest temperature at which measurement was possible, the other conditions being comparable for all the iodides.

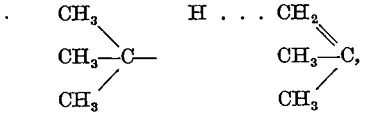
Iodide	Suggested bond energy	
Ethyl	52·5 kcal.	
Vinyl	56·6	Partial double-bond character.
Phenyl	54·0	
Allyl	39·0	Radical degeneracy
Benzyl	44·0	
Acetonyl	45·5	
t-Butyl	45·1	
Benzoyl	44·5	
Acetyl	(50·7)	

Taking ethyl iodide as our zero of reference, we note the manifestation of partial double bond character in vinyl iodide and in phenyl iodide, which is to be explained by a degeneracy of the type[3]

$$H_2C = CH - I \qquad H_2\overset{-}{C} - CH = \overset{+}{I}.$$

On the other hand, benzyl, allyl and acetonyl iodides clearly indicate the degeneracy of the free radical resulting from conjugation of the unshared electron with the double bond or the benzene ring.

These two effects appear to affect jointly the C – I bond in benzoyl iodide which is weakened, but to a lesser extent than in benzyl iodide. The somewhat uncertain value for acetyl iodide may be left undiscussed; but attention should be directed to the strong reduction in bond strength in *t*-butyl iodide. This points to a degeneracy of the free radical of the type



in which the representation containing the double bond is present in nine different forms, as compared with only three forms of this type resonating in the ethyl radical[4].

The magnitude by which the bond strength appears to vary in our experiments is of the order which might be theoretically expected. For example, in the case of allyl iodide and benzyl iodide the resonance energies of the radicals were calculated at 15·4 kcal.[5] and 15 kcal.[6] respectively, while our experiments indicate values of 13·5 kcal. and 9 kcal. The agreement would be improved if the resonance energy of the ethyl radical which might amount to 2-3 kcal. were taken into account.

As regards our absolute values, we note that the average bond energy attributed to C – I of about 45 kcal. is based on a C – H value of about 87 kcal.[7] On the other hand, all estimates agree that the energy required to break the first C – H bond in methane is more than 95 kcal.[8] and that in consequence C – I in methyl iodide is at least 53 kcal. This disagrees with the value of 43 kcal. found by Ogg[9] for methyl iodide, as well as for ethyl and *n*-propyl iodides, and lends support to our result of 52·5 kcal. for ethyl iodide.

E. T. BUTLER.
M. POLANYI.

The University,
Manchester.

---

[1] Rice, F. O., *et al.*, *J. Amer. Chem. Soc.*, **54**, 3529 (1932); **55**, 4245 (1933); **56**, 214 (1934).

[2] Ogg, R. A., and Polanyi, M., *Trans. Far. Soc.*, **31**, 604 (1935). Jones, J. L., and Ogg, R. A., *J. Amer. Chem. Soc.*, **59**, 1931, 1939, 1943 (1934). Jones, J. L., *J. Amer. Chem. Soc.*, **60**, 1877 (1938); **61**, 3284 (1939).

[3] Brockway, L. O., Beach, J. Y., and Pauling, L., *J. Amer. Chem. Soc.*, **57**, 2705 (1935). Brockway, L. O., and Palmer, K. J., *J. Amer. Chem. Soc.*, **59**, 2181 (1937). Ketelaar, J. A. A., *Rec. Tra. Chim.*, **58**, 266, 302 (1939).

[4] Evans, M. G., and Polanyi, M. discuss this type of resonance in a forthcoming paper.

[5] Coulson, C. A., *Proc. Roy. Soc.*, A, **164**, 383 (1938).

[6] Pauling, L., and Wheland, G. W., *J. Chem. Phys.*, **1**, 367 (1933).

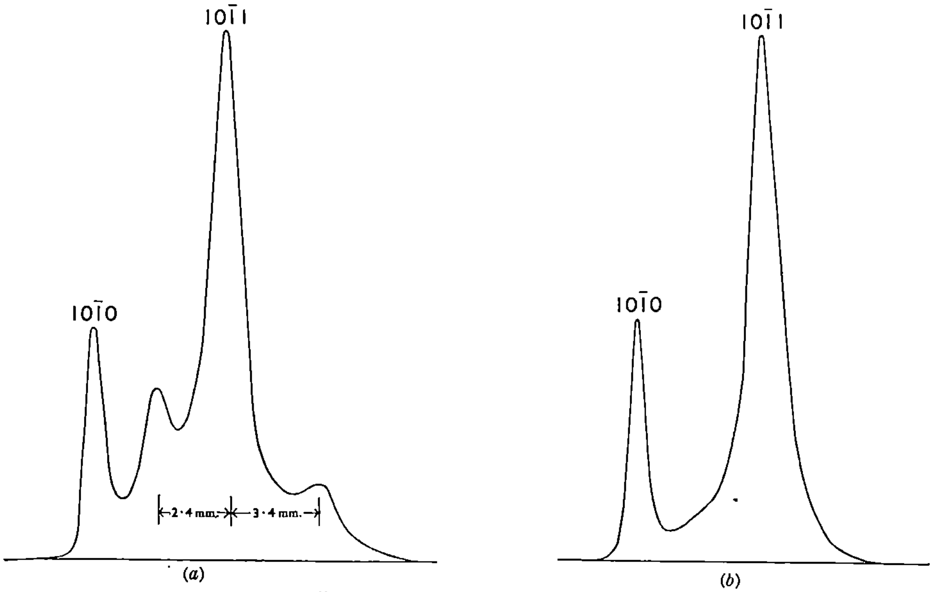
[7] Pauling, L., "The Nature of the Chemical Bond", 53.

[8] v. Hartel, H., and Polanyi, M., *Z. phys. Chem.*, **11**, 97 (1931). Trenner, N. R., Morikawa, K., and Taylor, H. S., *J. Chem. Phys.*, **5**, 203 (1937). Burton, M., *J. Chem. Phys.*, **7**, 1072 (1939).

[9] Ogg, R. A., *J. Amer. Chem. Soc.*, **56**, 526 (1934).

Anomalous Diffractions in the Hull-Debye-Scherrer Spectrum of Graphite

IN the course of an electron diffraction study of several graphites, Finch and Wilman[1] discovered a number of extra diffractions which could not be indexed in the normal way on the basis of the accepted crystal structure of graphite[2]. Of the extra diffractions, two embracing the $10\bar{1}1$ reflexion are clearly observed and cannot easily be accounted for. Because these extra lines occurred with graphites from very different sources, Finch and Wilman concluded that the possibility of impurity could be ruled out. Their main conclusion pointed to the presence of packets of planes with a thickness of 4 unit cells (or 9 layer-planes), in the direction of the c-axis. This would enable lines with fractional l indices to appear, because by analogy with a ruled grating with a few lines, the subsidiary maxima would begin to have the same order of magnitude as the principal diffractions. Thus the lines on either side of the $10\bar{1}1$ would seem to be $10\bar{1}\frac{2}{3}$ and $10\bar{1}\frac{4}{3}$.



MICROPHOTOMETER CURVES, $10\bar{1}0$–$10\bar{1}1$ GROUP, FOR CEYLON GRAPHITE (a) CLEANED WITH HYDROFLUORIC AND HYDROCHLORIC ACIDS, (b) CLEANED WITH HYDROFLUORIC AND HYDROCHLORIC ACIDS, AND 30 HOURS IN CONCENTRATED SULPHURIC PLUS NITRIC ACID MIXTURE.

We have repeatedly observed the extra lines with X-rays using a great variety of natural and artificial graphites. They are *not* a phenomenon entirely associated with the electron diffraction method. With cobalt K_α radiation, a Debye-Scherrer camera 19 cm. in diameter of the Bradley type, and a fine cylindrical specimen 0·3 mm. in diameter, very high resolution of these extra lines is obtained (Fig. a). The fact that all the spectra are reasonably sharp and no cross-grating spectra occur indicates that the graphite crystals are at least of the order of 1,000 A. in size. Careful cleaning of the graphite until the ash was zero failed to influence the intensity of the extra lines, so that the effect of impurity could be discounted. Only a very special chemical treatment affects the graphite. After all the inherent impurities have been removed by the usual methods, the graphite is wet-oxidized in a heated mixture of concentrated nitric and sulphuric acids in a 2 : 3 ratio by volume for 24 hours. This reduces the extra lines to almost zero intensity, but the other spectra remain unchanged (Fig. b). No other acid combination appears to work except concentrated sulphuric acid, which required more than 400 hours to produce the same effect.

The extra diffractions may arise from the dynamic stratification of the crystals in the manner suggested by C. V. Raman and P. Nilakantan[3], who observed extra spectra in the Laue photograph taken along the trigonal axis of diamond. Similar anomalies in Laue photographs have since been reported[4]. The wet oxidation treatment may reduce the size of the crystallites (although still bigger than 1,000 A.) so that the dynamic stratification becomes unstable because of edge effects and the extra lines are unable to appear. To some extent the dynamic stratification is analogous to the static packets of planes 4 unit cells deep as suggested by Finch and Wilman. It would be interesting to see if the dynamic stratification theory can be applied quantitatively to the appearance of these extra Debye-Scherrer reflections.

A. TAYLOR.

Magnesium Elektron Ltd.,
Clifton Junction,
Nr. Manchester.

D. LAIDLER.

King's College,
Newcastle-on-Tyne.

---

[1] Finch, G. I., and Wilman, H., *Proc. Roy. Soc.*, A, **155**, 345 (1936), *Erg. exakt. Naturwiss*, **16**, 353 (1937).

[2] Bernal, J. D., *Proc. Roy. Soc.*, A, **106**, 749 (1924).

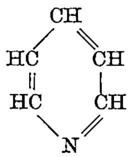
[3] Raman, Sir C. V., and Nilakantan, P., NATURE, **145**, 667 (1940).

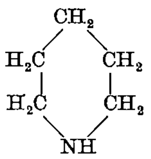
[4] Knaggs, I. E., Lonsdale, K., Müller, A., and Ubbelohde, A. R., NATURE, **145**, 820 (1940).

Nature of the Feulgen Reaction with Nucleic Acid

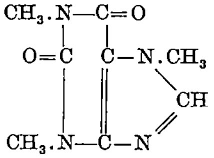
DURING the course of investigations into the probable chemical constitution of the nuclear contents in plants, many observations have been made in addition to the nucleolar staining reaction. Under existing conditions, it seems improbable that a full description of this work can be made for some time, and a note on an apparently significant point is offered here in the hope that it may lead to further useful developments.

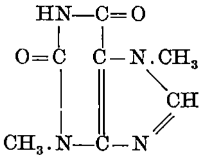
The use of the Feulgen nucleal reaction in connexion with cytological technique is proving to be of considerable importance for critical work. It is, of course, well known that this modified Schiff's reaction, now used with such marked success as a selective chromatin stain, is by no means specific for the HC : O group characteristic of aldehydes. While it is generally stated that the colour reaction is due to the available aldehyde group of the aldose in hydrolyzed nucleoprotein, it does not appear to have been previously reported that the leuco-base of fuchsine is also immediately restored to its original colour by such heterocyclic compounds as pyridine and piperidine.

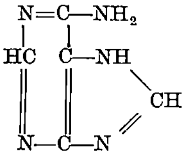

Pyridine

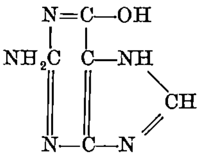

Piperidine

The significance of this observation in relation to the possible behaviour of the purine constituents of nucleoproteins will be at once apparent. Several tests were made on caffeine and theobromine with controls. The typical magenta colour was obtained with these after varying periods of time with different samples and preparations of leuco-base. Caffeine (Kahlbaum) gave a slight magenta colour after 5 minutes and a deep colour after 6 hours; theobromine (B.D.H.) similarly gave a magenta colour after a few minutes, which deepened after standing. It was apparent from this that adenine and guanine should also produce a magenta colour with the fuchsine.


Caffeine


Theobromine


Adenine


Guanine

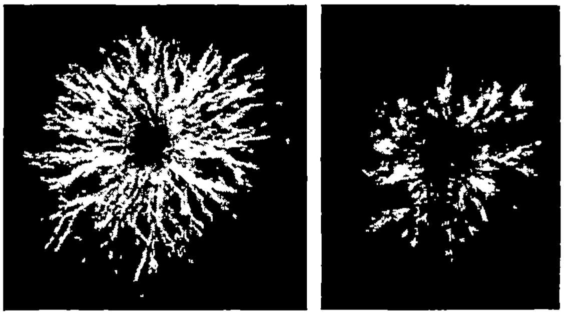
The probability was tested, using material supplied by the British Drug Houses, Ltd., and positive results were obtained, the characteristic colour appearing after 2–3 hours.

Generally, attention has been given primarily to the pentose constituent of nucleoprotein; but the matter seems to require further consideration. Tests with other components of a nuclear extract may, of course, be affected by the presence of traces of pentose, but the possibility of the reaction with chromatin being given by the purines seems to be strongly indicated by the positive reactions obtained with pure, redistilled pyridine. The peculiar specificity of the Feulgen reaction for the chromatin complex of plant and animal nuclei seems to become somewhat clearer in the light of these observations.

King's College, C. S. SEMMENS.
University of London
(at Bristol).
July 3.

Response of Isolated White Chromatophores of Crustacea to Change of Illumination

It is now generally accepted that the movements of pigment in the light-absorbing chromatophores of decapod Crustacea are controlled by the secretion or secretions of some tissue in the eye-stalks. In addition, many species possess chromatophores which contain a white light-reflecting pigment, the movements of which continue after the eyes and eye-stalks have been amputated. Therefore, it has been suggested that some tissue in the rostral region may affect these white chromatophores, by a secretion which is released in darkness under the control of some exteroceptor other than the eyes[1,2]. However, the results of injection experiments have indicated[3] that the diurnal movements of the white pigment are not under hormonal control, but that the white chromatophores behave as 'independent effectors'[4].


(*a*) (*b*)

(*a*) AN ISOLATED WHITE CHROMATOPHORE OF *Leander serratus*, IMMERSED IN A SOLUTION CONTAINING SODIUM CHLORIDE, CALCIUM CHLORIDE AND EYE-STALK HORMONE, UNDER ILLUMINATION.

(*b*) THE SAME CHROMATOPHORE AS IN (*a*) AFTER ONE HOUR IN DARKNESS.

To test the validity of the latter theory, portions of the carapace of *Leander serratus*, bearing one or two white chromatophores, were immersed in saline media, and examined under various conditions of illumination. Quantitative estimation of the pigment movements was obtained by measuring the diameter of the pigment masses with a micrometer scale. Two measurements were made at right-angles to one another.

In sea-water, isolated white chromatophores attained maximal expansion in a few minutes, but did not afterwards contract when they were placed in darkness. In the body-fluid of *L. serratus*, however, the isolated white chromatophores of this species expanded in light, contracted in darkness and later re-expanded when they were returned to the light. It has been shown[5] that the blood of *L. serratus* is hypotonic to sea-water and has an osmotic pressure which is maintained at a value equivalent to 2·6–2·9 per cent sodium chloride. Therefore, in subsequent experiments, the chromatophores were studied in media which were approximately isotonic to the blood of *L. serratus*.

In a sodium chloride solution the chromatophores contracted in darkness but failed to re-expand under illumination. However, when the chromatophores were placed in solutions containing calcium ions (see

THE CHANGE IN SHAPE OF SINGLE CHROMATOPHORES.

Each reading represents the mean diameter of 6–12 chromatophores. The diameter of each chromatophore was first recorded in light, later after the chromatophore had been one hour in darkness, and finally after the chromatophore had been re-exposed to illumination for one hour.

Medium	Diameter of chromatophores in μ			Percentage contraction	Percentage re-expansion
	Light 1 hr.	Dark 1 hr.	Light 1 hr.		
NaCl (2·7%)	635	508	508	30·9	0
$CaCl_2$ (3·4%)	612	425	537	35·6	19·3
NaCl (2·0%) + $CaCl_2$ (0·85%)	629	316	374	49·7	15·5
NaCl (2·0%) + $CaCl_2$ (0·85%) + eye-stalk hormone	578	316	527	45·5	40·0
Leander blood	1248	749	1105	39·9	32·2
Chromatophores of intact animals	645	305	645	52·5	52·5

table), they contracted in darkness and re-expanded under illumination. The time the chromatophores took to contract when isolated was similar to that taken in the living animal. The addition of small amounts of potassium or magnesium ions did not affect the movements of the white pigment. (The importance of calcium ions in the responses of chromatophores has already been emphasized[6].) The response of the isolated white chromatophores to change of illumination was improved by the addition of a small amount of eye-stalk extract (equivalent to 1/400 eye-stalk per ml.) to the medium. The sensitivity to change of illumination was maintained for a longer period in this way. Even so, the majority of cases the chromatophores lost their capacity to respond after they had been removed from the body for six hours, though in exceptional cases a response was obtained after twenty-four hours.

The white chromatophores of *L. serratus* are therefore independent effectors able to change their shape without either nervous or humoral control.

F. G. W. KNOWLES.

Marlborough College,
Wilts.
June 12.

[1] Hanström, B., *Kungl. Svenska. Veten. Handl.*, **3**, 16 (1937).

[2] Brown, jun., F. A., *J. Exp. Zool.*, **71**, 1 (1935).

[3] Knowles, F. G. W., *Pub. Staz. Zool. Nap.*, **17**, 174 (1939).

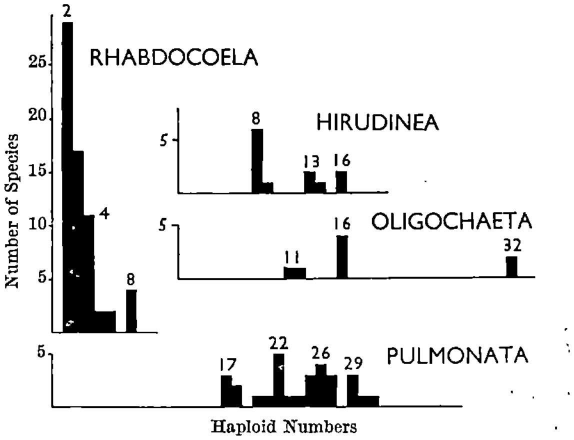
[4] Parker, G. H., "The Elementary Nervous System", 50 (Baltimore 1919).

[5] Panikkar, N. K., NATURE, **145**, 108 (1940).

[6] Koller, G., *Z. vergl. Physiol.*, **12**, 632 (1930).

Evidence for Polyploidy in the Hermaphrodite Groups of Animals

IT is now well known that a large number of species of higher plants are polyploids, and it is reasonable to infer that polyploidy has been one of the main evolutionary methods of species formation in the angiosperms. In animals a few instances of polyploidy are known in parthenogenetic forms (for example, in the Crustaceans Artemia[1] and Trichoniscus[2], the moth Solenobia[3] and some of the weevils[4]). Apart from these cases where polyploidy is associated with a complete abolition of the sexual process, there is little evidence for its existence in animals. It was pointed out by Muller[5] that polyploidy could not be expected to occur in groups of bisexual animals, since it would upset the sex-chromosome mechanism. In groups of hermaphrodite animals, however, there seems no *a priori* reason why polyploidy should not be one of the methods of species formation, just as it is in plants. In order to determine whether this is so, I have collected all the available chromosome numbers for the four main groups of hermaphrodite animals (Platyhelminthes, Oligochæta, Hirudinea and Pulmonate Mollusca). After eliminating early determinations which must be regarded as unreliable, the remaining data were plotted in the form of the accompanying histograms. In the case of the Platyhelminthes only the data for the Rhabdocœla were utilized, since very few chromosome numbers are known for the other classes of that phylum.



DATA DERIVED FROM VARIOUS AUTHORITIES

In the Rhabdocœla there is some definite evidence for the occurrence of polyploidy. Thus in the genus Mesostoma one species has a haploid number of 2, six of 4, one of 5 and one of 8. In Phænocora one species has a haploid number of 3 and one of 6. Actually, out of 65 species included in the graph, 17 are possible polyploids, that is, they have haploid numbers which are multiples of numbers known elsewhere in the group. The actual number of polyploid species is probably less than this, since some will have 'multiple' numbers without being polyploids.

In the Pulmonata there is no evidence of polyploidy. Of the 29 species in the graph not a single one could be a polyploid of any other. The only possible exception is *Helix pomatia*; the haploid number of this species was variously stated by the earlier authors as 12, 18 or 24. Actually it seems to be 27, and the early accounts were almost certainly inaccurate[6].

In the Hirudinea and Oligochæta relatively very few chromosome numbers have been determined. In both groups there are two possible polyploids (those with a haploid number of 16 in the Hirudinea and those with a haploid number of 32 in the Oligochæta). Until more cytological work has been carried out on these two groups it would, however, be premature to draw conclusions from the meagre data available.

We must therefore conclude that polyploidy has not occurred in the hermaphrodite groups of animals to anything like the same extent that it has done in most of the families of higher plants. In one group (the Pulmonata) it seems not to have occurred at all, while in the other three it has probably played only a minor role in species formation. It is possible that some special genetical barrier to polyploidy exists in animals; one could imagine that polyploid animals might be less viable than diploids owing to their cell-size being ill-adjusted to the increased chromosome number. Alternatively it is possible that although polyploid individuals may have arisen from time to time, they have not given rise to polyploid races or species owing to the rarity of self-fertilization in hermaphrodite animals. It is worth bearing in mind that in some groups of higher plants (for example, the Gymnosperms) polyploidy likewise seems almost entirely absent.

M. J. D. White.

31, Belsize Park,
London, N.W.3.
June 6.

---

[1] Artom, *Biologica*, 1 (1908); Barigozzi, *Boll. Soc. Ital. Biol. Sperim.*, 9 (1934); Gross, *Naturwiss.*, 20 (1932).

[2] Vandel, *Bull. Biol. Fr. Belg.*, 61 (1927).

[3] Seiler, *Biol. Zbl.*, 47 (1927).

[4] Suomalainen, *Hereditas*, 26 (1940).

[5] Muller, *Amer. Nat.*, 59 (1925).

[6] Perrot and Perrot, *Rev. Suisse Zool.*, 44 (1937).

Practical Science in Schools

I have naturally read with interest the communications from Dr. V. J. Chapman and from the Editors of Nature on this subject.

There is no attempt on my part to get practical work abolished in schools. It is essential for such examinations as the 1st M.B., Higher Certificate and university scholarships. The science specialist should devote, in my opinion, at least half his time to practical work. In so many of our public schools, however, it seems to be felt that if there are about five hundred boys altogether it is necessary to make provision for half of them to do practical work at once. As pointed out by the Editors of Nature a large majority of the boys complete their 'formal' education at the School Certificate stage and for this 'formal' education practical work is unnecessary. Had I my own way, and I am scarcely an anti-science teacher, I would make every boy in a public school learn Latin until he were either fifteen or had passed the School Certificate. Two good science lectures weekly with demonstrations are all that are required. The Latin learnt, however, would be the real thing and not Latin made easy. However, I will not try to dilate on this point.

Dr. Chapman's point about scholarship candidates knowing a good deal of advanced genetics but yet being unable to recognize a twig of larch leaves me almost unmoved. Experienced teachers and examiners will know of hundreds of parallel cases and they really signify nothing. No teacher, let alone the students, will tackle all parts of a vast subject with equal zest. I know of one scholarship candidate who tried to boil shrimps in a thick glass jam-jar, and another who was quite incapable of removing the gelatin from an old photographic negative. The former is a professor and the latter a fellow of his College. Both examiners and teachers might do well to remember such stories, even if they are not true, as that of Sir Isaac Newton who cut two holes in a door, a large one for the cat and a small one for the kitten. Even the greatest sometimes err and are human.

Dr. Chapman's contention that a plant or animal which has been cut up and handled can be more easily remembered, etc., though true, is open to criticism. Direct handling may be essential for the expert, but in general education it is by no means essential nor is it even always desirable. Is it even essential for a gynæcologist to have been a mother?

I certainly find myself at issue with the Editors of Nature when they say it is not the business of schools to train academic, professional and industrial experts but rather to produce intelligent and knowledgeable citizens. The public schools make a great effort to select the very best boys and surely these particular boys should be urged to aim at the very highest standard of attainment and be supplied with the best teaching possible. Really clever boys under the expert teacher should produce a standard of work which will have a tremendous influence on the school as a whole, though obviously no school could cater exclusively for the expert. I think, however, that many public schools, not to mention a few of the universities, might do well to remember sometimes that there is such a thing as a real teaching profession. The primary duty of any teacher is surely to make his students *learn*, and when a student has learnt to teach himself thoroughly he has gone pretty far in the right direction.

The really able boys in a public school are frequently well occupied with classics or mathematics, and even those who wish to specialize in science can often postpone much of their practical work. It is for the second- and third-rate boys who are never likely to get beyond the School Certificate that one apparently requires these palatial laboratories and costly apparatus.

Surely the War should make us reconsider the matter.

A. G. Lowndes.

Plymouth.

Common Salt as a Preservative

With reference to Mr. J. R. Norman's communication from Dr. Paul Chabanaud[1], I should like to support the opinion therein stated as to the value of common salt as a preservative for large specimens or when no other is available.

In the 'twenties I sent to the British Museum (Natural History) from this place, a distance of about 7,000 miles, two or three specimens of *Cephalorhynchus commersonii*, a dolphin 3–4 ft. in length, preserved with this reagent. The abdominal cavity was opened and salt stuffed in to capacity and the whole animal was covered with a heap of salt. Much of the fluid resulting ran away and as much as possible was drained off before packing in still more salt for dispatch. The method proved entirely satisfactory, the first specimen being, I believe, the original of the cast (♂) in the Whale Gallery of the Museum.

Salt was used for the preservation of the female genitalia of *Otaria byronia* illustrated in my recent paper on that species[2]. This specimen was about 14 cm. long and 11 cm. across the cornua and naturally very muscular. It was placed in a glass jar and covered with salt, fresh salt being added to keep the specimen covered as a saturated brine was formed which was poured off. More than a year later the specimen was taken from the salt, soaked in changes of fresh water until quite soft, and then very gradually brought up to alcohol of about 70 per cent. It remained perfectly flexible and was an admirable subject for dissection.

J. E. Hamilton.

Naturalist's Department,
Falkland Islands.
June 6.

---

[1] Nature, 145, 397 (1940).

[2] Hamilton, J. E., "A Second Report on the Southern Sea Lion, *Otaria byronia* (de Blainville)". *Discovery Reports*, 19, 121 (1939).

RESEARCH ITEMS

Stone Age Industries in Wyoming, U.S.A.

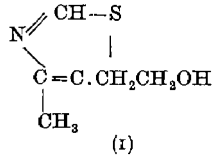
E. B. RENAUD's twelfth report (1940) on the University of Denver Archæological Survey of the High Western Plains deals with the fourth and fifth Denver-Wyoming Expeditions of 1938–39, which were directed to further research work on the stone age industries of Black's Fork Basin in south-west Wyoming. In addition to detailed accounts of field work and sites examined, a report on geological observations in 1938 and a summary of conclusions on the investigation as a whole are here included. Three distinct cultures have occupied Black's Fork Basin at different times and for prolonged periods. (1) The *Peripheral Culture*, of minor importance, sites in south-west Wyoming not being many or abundant in specimens. Though old it cannot be placed exactly in time. The artefacts are of dark chert, small and atypical, and their flaking of indifferent quality. (2) The *Sand Dune Culture* is essentially a camp culture with fireplace, one hand mano, slab metate, arrow-head, but no pottery. It resembles the Camp Culture of the High Western Plains. It is essentially a flake industry, southern and intensive in relation to the Peripheral Culture. (3) The *Typical Culture*, a complex lithic industry of which the component elements have been classified into three chert series, one of moss-agate and one, abundant, of quartzite. Four phases or periods are represented in which the relative number of flakes and unifaces as compared with biface and of sharp with smooth increases in inverse proportion to age. The sites represent extensive and very rich workshops. The artefacts have a distinct palæolithic look and display close similarity with Early and Middle Palæolithic of Europe and Africa. A pebble industry, many *coup-de-poing*-like pieces, and extensive practice of Clactonian flaking are three outstanding features of the industry. Unfortunately there is neither geological nor palæontological evidence to establish age.

Glass-making in Nupe, Nigeria

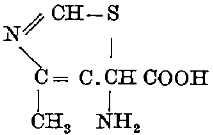
OBSERVATIONS of glass-making in Nupe recorded by Mr. S. F. Nadel (*Man* of June 1940) deal with the work of a guild of glass-makers (*masagá*) who make the real Nupe glass called *bikini* as against that which is obtained by melting down bottles (*kwálaba*). A completely new furnace must be used, not one that has been used for smelting iron. It is circular, approximating 5 ft. high and 2 ft. in diameter. It is covered on top with potsherds and broken calabashes which leave a small gap open. Four men work continuously, working the bellows in shifts, adding fuel, etc. The fire is kept up day and night for from two to five days. The raw material, sand and natron, is first prepared in two heaps in a neighbouring hut. The sand is that dug in making the furnace; the natron is bought from native traders coming down from the Chad. The sand and powdered natron are mixed to a fine powdery mixture, and a little water added to make it of a muddy consistency, the mixture then being placed on the bottom of the furnace. Wood and grass for the lighting of the fire are placed over it and left to burn for 6–7 hours. A little blacksmith's slag is added, washed down by considerable quantities of water. After about 18 hours the glass has become liquid. Samples are taken and after another eight hours the glass is said to be finished. The glass is removed as a red glowing pasty material and left to cool. The glass is stored in this form until required for use in making bangles, when it is melted and worked. In a note by C. G. Seligman it is added that a spectrographic examination by P. D. Ritchie of a mixture of one part of red earth to three of the alkaline product gives a spectrum almost identical with that of the finished Nupe glass and almost identical with that of the red siliceous earth. Only a minute trace of potash is present, the native alkali being essentially sodium carbonate, but containing a fair proportion of calcium. A portion of the mixture heated at 1200° C. for 24 hours produced a glass of poor quality containing nodules of undissolved silica from the red earth and a black glassy matrix resembling the black Nupe glass.

Biogenesis of Vitamin B_1

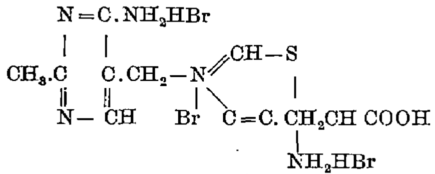
IT is of interest to discover why yeast is able to form such large amounts of B vitamins during its growth, and in particular what are the precursors of and reactions leading to the synthesis of vitamin B_1 (aneurin). C. R. Harington and R. C. G. Moggridge (*Biochem. J.*, 34, 685; 1940) have obtained support for their earlier suggestion that the 4 methyl-5-(β-hydroxyethyl)-thiazole (I) of aneurin might arise during yeast fermentation from α-amino-β-(4-methylthiazole-5)-propionic acid (II) by a reaction analogous to the formation of fusel oil in alcoholic fermentation. The fact that yeast is a rich source of aneurin and is able to effect this type of degradation further supported the hypothesis, and it has been found that the synthetic amino-acid (II) is indeed broken down by yeast to 4 methyl-5-(β-hydroxyethyl)-thiazole.



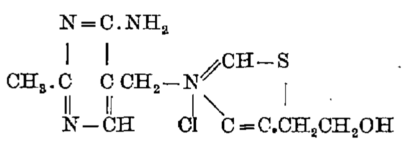
(I)



(II)



(III)



(IV)

The authors are attempting to extend the work by synthesizing the amino-acid (III) analogous to aneurin (IV). If compound (III) could be obtained its fermentation by yeast might be expected to give both aneurin and cocarboxylase (aneurin pyrophosphoric ester).

Ecology of the Estuary of the Aberdeenshire Dee

ALEC MILNE has recently published some interesting observations on ecological aspects of the intertidal area of the estuary of the Aberdeenshire Dee (*Trans. Roy. Soc., Edin.*, 15, Part 1 (No. 4), 1939–40 ; 1940). There is no up-estuary movement (tidal) of the surface layers of water of the Dee, and thus the surface salinity changes due to tidal alterations are less, though the fluctuation at any point in the intertidal area is consequently greater. There are fewer species of the larger animals which are common in the long estuaries, the main reason being the very high salinity fluctuations and the absence of mud flats. The commonest inhabitants are *Jaera marina* and *Gammarus zaddachi*, *Balanus balanoides*, *Procerodes ulvæ* and *Nereis diversicolor* ; *Fucus ceranoides* being the commonest seaweed. Salinity is apparently the chief factor determining distribution in the Dee estuary. There are in the intertidal fauna large numbers of individuals of certain forms.

American Aphids of the Genus Myzus

Miscellaneous Publication No. 371 of the U.S. Department of Agriculture, March 1940, is devoted to an article on this subject by Preston W. Mason of the U.S. Department of Entomology and Plant Quarantine. Several species of the genus are of considerable economic importance, especially in connexion with fruit, market garden and ornamental plants. In addition to the direct injury which they cause to the plants, certain species of Myzus are vectors of virus diseases. Thus *Myzus persicæ* is a known carrier of more kinds of virus diseases than any other species of insect. It is, furthermore, one of the widest distributed of all insects and occurs in all parts of the world where aphid life can exist. *M. convolvuli* has been proved to transmit virus diseases of potatoes, and the new species *M. lilii* is a suspected transmitter of disease among *Lilium candidum*. The article is illustrated by figures showing the diagnostic characters of the various species found in America. Eight of the species dealt with occur also in Europe, and their descriptions, etc., will be found useful in cases of doubtful identification.

Spreading of Spray Fluids

THE wetting and spreading properties of certain spray fluid supplements have been determined by H. Martin (*J. Pom. and Hort. Sci.*, 18, 34 ; 1940). Surface tension, spray retention, area of spread and contact angles on artificial surfaces were determined for twenty different water-soluble products of potential value as spray spreaders. A high degree of correlation was found between advancing and receding contact angles in the case of long-chain compounds, but the correlation was not so close with certain surface-active materials of cyclic structure. Advancing and receding contact angles are distinct entities, the former related to spreading and penetration and the latter determining wetting performance. The area of spread of a liquid droplet is related both to contact angle and spreading coefficient on a given surface, but practical difficulties arise in the use of this as a criterion of wetting and spreading properties. The volume of spray retained under standard conditions on a vertical surface is determined by the receding contact angle, and provides a suitable means of assessing the wetting and spreading properties of both aqueous solutions and heterogeneous spray systems. Chemical analysis, on the other hand, is an unreliable method of assessing spray performance.

Cultural Control of Smut Fungi in Egypt

THE particular methods of cereal culture necessitated by the geographical position of Egypt make possible the control of several smut fungi without the employment of costly insecticides (G. Howard Jones and Abd El-Ghani Seif El-Nasr Eff, "Control of Smut Diseases in Egypt with special reference to Sowing Depth and Soil Moisture", *Min. Agr. Egypt Tech. and Sci. Service Bull.*, No. 224. Cairo : Government Press, Bulâq. P.T.6. 1940). The 'herati' method of sowing in moist soil, and the 'afir' type of planting, where irrigation follows seeding in dry soil, involve differences in the relative depths of sowing, and in the moisture content of the ground. These two factors, with the effect of temperature, appear to control the incidence of flag smut of wheat caused by *Urocystis tritici*, covered smut of barley, *Ustilago hordei*, bunt of wheat, *Tilletia fœtens*, and grain smut of millet and broom corn, *Sphacelotheca sorghi*. The relatively long passage of a coleoptile from deeply sown grain through moist soil apparently gives more chance of infection than the quick shoot emergence from shallow sowings in drier soil. Infection is much greater when the average ground temperature for ten days after planting lies between 13° and 17° C. Practical suggestions for new methods of sowing are made (see also NATURE, 142, 917 ; 1938).

Genetics and Long-day Plants

T. M. Little, J. H. Kantor and B. H. Robinson (*J. Hered.*, 31, 73–77) show that virescent foliage and early flowering in the African marigold (*Tagetes erecta*) are both inherited as Mendelian recessives. The virescent character is pronounced under temperatures between 55° and 75°, but when hotter conditions are present the virescent plants can scarcely be distinguished from normal. But low temperatures alone will not permit the expression of the character since it is found that the virescent character does not appear in plants grown near the United States–Mexican border, where the temperature ranges from 32° to 70°, but the day is shorter. Early flowering is not influenced by temperature, but length of day greatly affects the character. In winter, all plants come into bloom in eleven weeks, but in spring normal plants take seventeen weeks to flower while the early flowering strain takes twelve weeks.

Selective Fertilization in the Raspberry

D. LEWIS (*Genetics*, 25, 278–286 ; 1940) shows that a gene w inhibits and severely retards pollen-tube growth in the raspberry. w is linked with t and g which are also in the same linkage group as b and x. The order of the genes is B, T, G and W. It was found that the single factor ratios of $T : t$ and $G : g$ were frequently distorted as the result of the linkage with $W : w$.

Genetics of Awns in Triticum

A. E. Watkins and S. Ellerton (*J. Genetics*, 40, 243–270 ; 1940) discuss the literature and give results of their experiments on the inheritance and behaviour of awns in wheat. They show that hexaploids usually have shorter awns than tetraploids and that there are both major and modifying genes which affect size of awn. Beardless is the bottom recessive character as compared with tipped-1, B_1, half awned b_1^a, B_2, half awned A and hooded Hd. B_1, b_1^a, and b_1 are allelomorphic with one another, while B_2 A and b_2 may also be multiple allelomorphs. The genes B_1, B_2 and Hd may be transferred to tetraploid wheats and there segregate regularly. B_1 is linked with pubescent node, square-headedness, and keeled glumes.

Plasticity Conditions for Fault Formation

A VERY valuable mathematical paper on plasticity conditions requisite for the formation of normal and reverse faults has been written by Katsutada Sezawa (*Bull. Earthquake Res. Inst., Tokyo*, **17**, Part 4, 661–674; 1939). Three idealized models were chosen: (1) spherical, (2) cylindrical, (3) plane. Sezawa inferred that when the liquid earth partly solidified, the solidified parts changed from incompressible to compressible. If there were no faults in the earth, the lateral compression in any particular place would exceed the vertical, thus giving rise to reverse faults. With the aid of mathematical plasticity the direction of the fault causing stress is obtained. On the maximum shear stress theory the inclination of the reverse fault would be 45° to the horizontal, but owing to frictional force on the sliding surface the theory has to be modified and the angle is likely to be only 10° or 20°. When the solidified earth has faults, the stress conditions are different. The plastic state is nearly the same as that of the earth with a plane surface. The horizontal compression is less than the vertical, and the formation of normal faults is highly probable. Owing to frictional force on the sliding surface, the inclination of normal faults to the horizontal is more than 45°, say 60°. Sezawa infers that it is probable that such fault surfaces as lie near so large a trench as the Japan Trench are reverse faults, which were formed at a very early stage in the life of the solid earth. The usual smaller faults on land would be normal faults formed at a relatively later stage in the history of the solid earth. It is possible that deep-focus earthquakes are in some way related to reverse faults, and in the present state of the earth's crust, plastic stresses causing reverse and normal faults might still remain.

Thunderstorms at Karachi

DURING the past three years, the study of the thunderstorms at Karachi has been followed by B. N. Desai and S. Mal, of the India Meteorological Department. Their work was first introduced to English meteorologists in a paper entitled "The Mechanism of Thundery Conditions at Karachi" (*Q. J. Roy. Met. Soc.*, **64**, 525–37). Owing no doubt to the reorganization of the India Meteorological Department, more than two years have elapsed between the time when the material of their latest paper was first communicated to the Department, and its appearance as "A Discussion of Some Aeroplane Ascents at Drigh Road (Karachi) on days of Dust Storms, Thunderstorms and Dust-Raising Winds" (*Sci. Notes India Met. Dep.*, **8**, No. 87). The observations made during these aeroplane ascents are set out on the now familiar tephigram system, both dry- and wet-bulb readings being plotted. It appears that the knowledge about latent instability of the atmosphere gained from early-morning ascents was not always found to be sufficient for the prediction later in the day of dust-raising winds owing their origin to thunderstorms, and that for this purpose the weather of surrounding regions had to be taken into account. A distinction is drawn by the authors between thundery conditions that do not result in winds of Beaufort force 6 or more, and conditions which do give such winds, because of the importance for aviation of knowing whether a dust haze or dust storm is likely to develop. There does not appear from this work to be any fundamental difference between the incidence of thunder in the peculiarly damp and enervating climate of Karachi and its incidence in a bracing climate like that of, say, East Anglia. In both regions strong thunder squalls are far more likely when the thunder is associated with winds of widely different origin than when there is only the local development of instability from unequal heating within a single air mass.

Chlorine Monoxide and Water

IT is known that chlorine monoxide dissolves in water to form hypochlorous acid, but no solid hydrate was known. C. H. Secoy and G. H. Cady (*J. Amer. Chem. Soc.*, **62**, 1036; 1940) have prepared pure chlorine monoxide (made by the action of chlorine mixed with air on yellow mercuric oxide) and find the freezing point of a freshly prepared sample, dried by passing the gas over phosphorus pentoxide, to be – 120·6°. The compositions of saturated solutions in water (20·7 mol per cent at 236·8° K. to 22·9 mol per cent at 263·8° K.) were determined. Chlorine monoxide and water form a pair of partially miscible liquids. The solid phase formed from solutions of concentration greater than 11·7 mol per cent was found to be the crystalline dihydrate of hypochlorous acid, $HOCl, 2H_2O$.

Dipole Moments and Structures

MEASUREMENTS of the dipole moments of hydrogen disulphide, sulphur monochloride, selenium monochloride, selenium oxychloride, phosphoryl chloride and thiophosphoryl chloride in benzene or heptane (C. P. Smyth, G. L. Lewis, A. J. Grossman and F. B. Jennings, *J. Amer. Chem. Soc.*, **62**, 1219; 1940) have been used to obtain information of structures. H_2S_2 may be explained by H—S—S—H, but better if a small proportion of branched molecules H_2S—S are present. S_2Cl_2 and Se_2Cl_2 may be explained with difficulty by Cl—S—S—Cl and Cl—Se—Se—Cl, but better by branched structures S—SCl_2 and Se—$SeCl_2$ in the form of an irregular tetrahedron, or a mixture of extended and branched structures. The values for the moments of the bonds calculated are: SeO in $SeOCl_2$, 3·0; $\overset{+}{\mathrm{P}}—\overset{-}{\mathrm{O}}$ in $POCl_3$, 3·5; $\overset{+}{\mathrm{P}}—\overset{-}{\mathrm{S}}$ in $PSCl_3$, 2·5. The third is lowered to a greater extent by induction than the second.

Sunspots during 1937

THE Astronomer Royal has discussed the mean areas and heliographic latitudes of sunspots during 1937 (*Mon. Not. Roy. Astro. Soc.*, **100**, 6; April 1940). The results are in continuation of those given in *Mon. Not. Roy. Astro. Soc.*, **98**, 425 (1938), and are derived from the measurement at Greenwich of photographs taken at the Royal Observatories of Greenwich and the Cape and at the Kodaikanal Observatory, India. They are summarized in four tables, and it is interesting to notice that on no day in the year 1937 were sunspots and faculæ absent from the sun's disk. For the first three years of the present cycle, the southern hemisphere was the more active, but during 1937 the northern hemisphere showed more activity, the ratio of the mean daily area of sunspots, north and south of the equator, being 1·7 : 1. The mean latitudes of all spots, weighted according to the area, is 17·02°, which is 3·3° nearer the sun's equator than in 1936.

DETERMINATION OF THE SIZES OF VIRUSES AND GENES BY RADIATION METHODS

By D. E. LEA,
STRANGEWAYS RESEARCH LABORATORY, CAMBRIDGE

IT has been shown recently that viruses[1,2] and phages[3] are inactivated by exposure to ionizing radiations, that is to X-rays or the various radiations from radioactive substances. It appears that the inactivation process is of a particularly simple and direct type, a single ionization or cluster of ionizations being capable of inactivating a particle of the phage or virus.

Two lines of evidence lead to this conclusion. In the first place, if the size of the virus particle is approximately known, and if the dose of radiation needed for inactivation is expressed in terms of ionizations per cm.³ in the biological material, it is found that this dose corresponds, at any rate in order of magnitude, to one ionization in a volume equal to the volume of the virus particle.

The second argument is more precise though less direct, and is based on internal evidence from the radiation experiments themselves. These show that the effect of a given *dose* of radiation is independent of the *intensity* at which it is delivered, and further that the inactivation process follows the law of a monomolecular reaction, that is, the proportion surviving diminishes exponentially with the time for which the radiation acts. These experimental facts indicate that the inactivation is of the nature of a single unit process, the line of argument being one familiar in radiobiology (see for example refs.[3,4,5,6,7]).

The possibility is thus presented of using the radiation experiments as a means of determining the size of the virus particles. If the inactivation dose, that is, that dose leading to reduction of the proportion surviving to e^{-1}, is n ionizations per cm.³, then one would argue that the volume, v, of the virus is given by the equation $n = 1/v$. Certain complications involving the spatial distribution of the ionizations lead to some modification of this simple relation. In the first place, ionizations occur in small clusters, sufficiently compact to behave as single units and averaging 3 ionizations per cluster, so that the inactivation dose becomes $3/v$ ionizations per cm.³. These clusters of ionization are distributed along the paths of ionizing particles which travel in approximately straight lines through the material, and in some cases the separation of the clusters is small, so that an ionizing particle which passes through a virus particle inevitably leaves several clusters of ionization in it. If the mean number of clusters left in a virus by an ionizing particle which inactivates it is F, then the inactivation dose becomes $3F/v$ ionizations per cm.³ F clearly depends on the diameter of the virus ($2r$) and the mean separation (L) of consecutive clusters along the path of the ionizing particle, and may be calculated[5].

I quote in Table 1 a recent experimental determination by Wollman, Holweck and Luria[3] of the inactivation doses of phage 16 for three different radiations, and deduce for each the value of $2r$, the diameter of the phage particle, which would make the experimental inactivation dose equal to $3F/v$. To obtain the doses in ionizations per cm.³ from the measured doses in roentgens the latter are multiplied by a factor which varies a little for different radiations depending on the relative absorption of tissue and air, the extreme values being $2 \cdot 6 \times 10^{12}$ for α-rays and $1 \cdot 3 \times 10^{12}$ for soft X-rays.

TABLE 1. RADIATIONS ON PHAGE 16

Radiation	X-rays (0·15 A.)	X-rays (0·71 A.)	α-rays
Ion clusters per cm.	$2 \cdot 1 \times 10^5$	$3 \cdot 3 \times 10^6$	$1 \cdot 5 \times 10^7$
Value of F	1·44	1·82	85
Inactivation dose (ions per cm.³)	$6 \cdot 7 \times 10^{16}$	$6 \cdot 0 \times 10^{16}$	$7 \cdot 9 \times 10^{17}$
Diameter of phage	50 mμ	56 mμ	85 mμ

The estimate of the diameter of the virus from ultra-centrifugation and ultra-filtration experiments is quoted by the authors as 50–75 mμ, which is seen to be in agreement with the values deduced from the radiation experiments.

Table 2 shows some preliminary results[2] on the inactivation of tobacco necrosis virus by X-rays, which have been used in a similar manner to determine the diameter of the virus. The diameter deduced from ultra-filtration experiments[8] is 12–20 mμ, and this value is seen to be in good agreement with the values derived from the radiation experiments.

TABLE 2. INACTIVATION OF TOBACCO NECROSIS VIRUS

Radiation	X-rays (1·5 A.)	X-rays (8·3 A.)
Ion clusters per cm.	5×10^5	$2 \cdot 4 \times 10^6$
Value of F	1·40	2·60
Inactivation dose (ions per cm.³)	$1 \cdot 2 \times 10^{18}$	$6 \cdot 1 \times 10^{18}$
Diameter of virus	19 mμ	14 mμ

In the examples so far cited the knowledge of the inactivation dose to any one radiation suffices to determine the size of the virus or phage concerned, and the use of several different radiations merely serves for confirmation. We come now to consideration of a more complicated case, in which the comparison of the effects of two radiations of very different ionization density is the essential experimental datum. In experiments on the production of sex-linked recessive lethal mutations in Drosophila by irradiation of the sperm, the effect observed is due to the inactivation by the radiation of any one of the large number (N) of genes in the X-chromosome capable of being modified in this way, and since N is not known (except as to order of magnitude[9]), observations of the production of lethals by one radiation does not enable the gene size to be determined. However, the ratio of the doses of two different radiations required to produce the same percentage of lethals does not involve N, but only the ratio of the values of F for the two radiations. Since the quantity F depends on the diameter of the gene, this last may be calculated. In Table 3, it is shown that the experimental results with three different radiations may be satisfactorily fitted by assuming that there are 1,860 genes in the X-chromosome having an average diameter of 3·78 mμ.

TABLE 3. SEX-LINKED LETHAL MUTATIONS IN DROSOPHILA

Radiation	X-rays	Neutrons	α-rays
Ion clusters per cm.	2×10^{5}	$3·7 \times 10^{6}$	$1·6 \times 10^{7}$
Value of F	1·03	1·60	4·3
% mutations per 1,000 r, calculated	2·89%	1·86%	1·08%
% mutations per 1,000 r, experimental	2·95%[4]	1·85%[10]	0·84%[11]

While these figures are to be regarded as preliminary in view of the fact that N in particular is very sensitive to any error in the experimental determination, it is likely that the radiation method will, with sufficient experimental precision, become the best method of determining the size and number of genes in Drosophila. $2r$ is, of course, strictly the diameter of the region or 'target' associated with a gene within which an ionization must be produced to cause a mutation of that gene. The closeness of the correspondence between the size of the target and the size of the biological entity in the case of the phage and virus work makes it probable, however, that the distinction between the size of the gene and the size of the target is not an important one.

Besides the inactivation of viruses and the production of gene mutations, there are other biological actions of radiation which have been interpreted in terms of the existence of 'targets' or regions of special sensitivity in the organism. It is probable that in some of these cases this interpretation is unsound, in others the size of the target has been incorrectly deduced owing to data not being available for a sufficient number of different radiations. The lethal action of radiations on bacteria, which has been investigated by many authors, provides a case in point. In the past it has been usual to assume that the target in this case consists of a single sphere, and estimates for its diameter of the order of a few tenths of a micron have been given[7,12]. When data are available, however, for a number of radiations covering a sufficiently wide range of ion density, it appears that the assumption of a single large spherical target cannot be made to fit the results, but the assumption of a large number of small spherical targets is more successful. It appears highly probable that the lethal effect of radiations on bacteria is to be interpreted as the production of lethal mutation, there being a large number of genes in the bacterium any one of which inactivated prevents the organism from developing into a visible colony when plated out. In Table 4 theoretical estimates of the lethal dose for *Bact. coli* are calculated by the same procedure as was used for the calculation of gene mutation production in Table 3, it being assumed that the organism contains 1,150 genes of diameter 8·6 mμ.

TABLE 4. LETHAL MUTATIONS IN *Bact. Coli.*

Radiation	β- or γ-rays	X-rays (1·5 A.)	X-rays (8·3 A.)	α-rays
Ion clusters per cm.	3×10^{4}	5×10^{5}	$2·4 \times 10^{6}$	$1·3 \times 10^{7}$
Value of F	1·01	1·16	2·00	7·65
Mean lethal dose in r, calculated	$4·6 \times 10^{1}$	$6·9 \times 10^{3}$	$10·3 \times 10^{3}$	23×10^{3}
Mean lethal dose in r, experimental	$4·6 \times 10^{3}$ [7]	$6·5 \times 10^{3}$ [13]	$7·5 \times 10^{3}$ [13]	24×10^{3} [7]

While the radiation method has so far had a relatively limited application, enough examples have been given above to indicate that it is a powerful tool for the investigation of biological entities of subcellular size.

---

[1] Gowen, J. H., *Proc. Nat. Acad. Sci.*, **26**, 8 (1940).

[2] Lea, D. E., and Smith, Kenneth M., *Parasitology* (in the press); also unpublished results.

[3] Wollman, E., Holweck, F., and Luria, S., NATURE, **145**, 935 (1940).

[4] Timoféeff-Ressovsky, N. W., "Mutationsforschung" (Dresden, 1937).

[5] Lea, D. E., *J. Genetics*, **39**, 181 (1940).

[6] Crowther, J. A., *Proc. Roy. Soc.*, B, **100**, 390 (1926).

[7] Lea, D. E., Haines, R. B., and Coulson, C. A., *Proc. Roy. Soc.*, B, **120**, 47 (1936); **123**, 1 (1937).

[8] Smith, Kenneth M., and McClement, W. D., *Parasitology* (in the press).

[9] Muller, H. J., and Prokofyeva, A. A., *Proc. Nat. Acad. Sci.*, **21**, 16 (1935).

[10] Zimmer, K., and Timoféeff-Ressovsky, N. W., *Strahlentherapie*, **63**, 528 (1938); *Phys. Rev.*, **55**, 411 (1939).

[11] Calculated from the experiments of Ward, F., *Genetics*, **20**, 230 (1935).

[12] Wyckoff, R. G., *J. Exp. Med.*, **52**, 435 (1930); Lacassagne, A., and Holweck, F., *C.R.*, **188**, 197 (1929); Jordan, P., *Radiologica*, **2**, 16 (1938).

[13] Lea, D. E., and Haines, R. B. (in course of publication).

FRICTION AND SURFACE FINISH

By Prof. Jerome C. Hunsaker,

Massachusetts Institute of Technology

CONFERENCES on Friction and Surface Finish were held at the Massachusetts Institute of Technology during June 5–7 under the joint auspices of the Departments of Mechanical Engineering and Metallurgy. Representatives of the automobile, aviation, oil, machine tool, grinding, general machinery and other industries took part. The object of the Conferences was to bring before engineers associated with the many industries concerned, a summary of present knowledge regarding friction and finish, and to bring out by discussion an appreciation of what new information is needed and an indication of the most promising directions for future research. The discussion was too extensive to report here, but the following notes indicate matters which were especially interesting to those present.

A. F. Underwood (General Motors Research Laboratories) reviewed the general problem of fluid and boundary lubrication from the automobile engineer's point of view. He discussed the current practice of surface preparation of bearings, pistons, cylinders, cams and gears, and pointed out that the metals that make good bearing materials all lie in certain specific parts of the periodic table. The failure of bearing metals through fatigue was also discussed.

John Wulff (M.I.T.) has determined, by means of electron diffraction studies of the ferrite induced by cold work in 18–8 stainless steel, the depth of disturbance in a metal produced by various methods of surface finishing. The disturbance due to wet or dry grinding goes much deeper than that due to lapping or super-finishing.

Aspects and problems of lubrication and surface finish peculiar to the aircraft industry were discussed by Leonard Hobbs (Pratt and Whitney Aircraft), and D. A. Wallace (Chrysler Corporation) described the method of super-finishing and cited examples of improvement in operation of automobiles obtained thereby.

J. T. Burwell (M.I.T.) reported on the effect of surface finish on the metal worn off a journal during 'running-in' and also its effect on the friction coefficient and load capacity of a journal bearing. He finds that the load capacity increases and the minimum coefficient of friction decreases with increasing surface smoothness.

David Harris (Gillette Razor Company) discussed the surface finishing of razor blades, and described a machine for grading bonded abrasive stones and wheels.

Stewart Way (Westinghouse Research Laboratories) described the various methods of describing and measuring surface profile. These include cutting and polishing a section, optical methods, and mechanical methods. The errors and limitations of each method were discussed; none is good for measuring profiles of which the maximum deviation from a median plane is less than 10 micro-inches. H. R. Nelson (Battelle Memorial Institute) described a technique for describing surface profiles by means of nickel plating the surface and then grinding and polishing a section at an angle of 2° with the surface. The borderline in this section between the nickel plate and the specimen is a twenty-five fold magnification of the actual profile. The whole can then be photomicrographed at any additional magnification desired.

Hans Ernst and M. E. Merchant (Cincinnati Milling Machine Co.) proposed an expression for the friction coefficient between rubbing surfaces:

$$\mu = \frac{S}{H} + \tan\theta,$$

where S is the shear stress of the weld formed between the two surfaces, H is the hardness of pressure of fluidity of the weaker, and θ is the average slope of the surfaces. The first term accounts for the molecular adhesion in surface friction and the second term for the interlocking of asperities. Experiments conducted on dry, clean surfaces in a vacuum substantiate this formula.

Otto Beeck (Shell Development Company) described friction measurements using the four-ball machine of Bourlage on E.P. lubricants and also electron diffraction studies of the surface films produced by these lubricants. He finds a constant coefficient of friction below a certain critical speed for these lubricants and suggests calling this the region of boundary lubrication. The action of most E.P. lubricants is to form a metal phosphide, arsenide, etc., the eutectic mixture of which with the metal has a much lower melting point with resultant decreased resistance to shear. R. W. Dayton (Battelle Memorial Institute) described various laboratory methods of measuring wear between rubbing metal surfaces. He stated that wear due to mutual abrasion of rough surfaces is not very common, and showed that even very small amounts of adventitious dirt in a lubricating oil can greatly increase wear. He also discussed failure of bearing metals through fatigue.

O. R. Schurig (General Electric Company), who reviewed the course of the conference, emphasized that the degree of smoothness of a rubbing surface should depend entirely on the use to which it is to be put. He stated that the load capacity of a sand-blasted surface as measured in an Almen testing machine is greater than that of a fine-ground surface.

F. Morgan (Gulf Research Laboratories) described a repetition of Bowden's experiments measuring the temperature flash during the 'slip' portion of a 'stick-slip' cycle and stated that for moderate speeds a temperature rise of only 30° C. could be observed in contrast to Bowden's observation of several hundred degrees rise.

W. E. Campbell (Bell Telephone Laboratories) reported on measurements of static friction between dissimilar dry metal surfaces. He has obtained good agreement with the results of Ernst and Merchant. He finds that the presence of moisture in the air raises the static coefficient of friction, and the presence of water in a lubricant also does the same thing.

ANAEROBIC DEGRADATION OF CYSTINE AND CYSTEINE

THE bacterial degradation of cystine and cysteine under anaerobic conditions with liberation of hydrogen sulphide and ammonia has recently formed the subject of interesting papers by Desnuelle, and by Desnuelle, Wookey and Fromageot. The former author worked with suspensions of non-proliferating *B. coli*[1], whereas the latter authors used suspensions of propionic acid bacteria[2]. A systematic study by Tarr[3] of the production of hydrogen sulphide by washed bacterial suspensions showed that cysteine and cystine are decomposed anaerobically by numerous bacteria with formation of hydrogen sulphide. Desnuelle and Fromageot[4] pointed out that a specific enzyme which they termed cysteinase was responsible for the breakdown of the amino acid.

The results with *B. coli* now indicate that the following changes take place in the anaerobic breakdown of cystine:

1. $l(-)$ cystine + $DH_2 \rightarrow 2l(+)$ cysteine + D.
2. $2l(+)$ cysteine $\rightarrow 2H_2S + 2NH_3$ + other products.

Process (1) involves the co-operation of a hydrogen donator DH_2 whilst process (2) is catalysed by cysteinase. The presence of glucose, and to a less extent fructose, greatly accelerates the formation of hydrogen sulphide from cystine; these sugars acting apparently as hydrogen donators. The presence of molecular hydrogen does not markedly affect the process, though it is known that *B. coli* is able to activate molecular hydrogen as a hydrogen donator. The presence of formate, which is a most vigorous hydrogen donator in presence of *B. coli*, has the remarkable effect of inhibiting the formation of hydrogen sulphide from cystine. The process of breakdown of cysteine or cystine by *B. coli* seems to be confined to $l(+)$ cysteine and $l(-)$ cystine.

Results with resting propionic acid bacteria also show an accelerating effect of glucose on the anaerobic formation of hydrogen sulphide from cystine, but the kinetics of the reaction differ from those obtained with *B. coli*. There is not the rigid optical specificity of reaction which takes place in the case of *B. coli*, and both *l*- and *d*-cysteine are equally well attacked. Ammonia formation does not proceed parallel with that of hydrogen sulphide; in fact, in the presence of glucose, which accelerates hydrogen sulphide production, ammonia formation is greatly retarded. Both alanine and pyruvate inhibit the anaerobic breakdown of cysteine by suspensions of propionic acid bacteria.

[1] *Enzymologia*, **6**, 242, 387 (1939).

[2] *Enzymologia*, **8**, 225 (1940).

[3] *Biochem. J.*, **27**, 759, 1869 (1933).

[4] *Enzymologia*, **6**, 80 (1939).

POPULATION PROBLEMS IN INDIA

THE second Indian Population Congress was held at Bombay in 1938 and its results are now published in a large volume*. Practically every aspect of the population problem is examined, with special reference to India. The numerous papers, many of them by men and women of high attainment and expert knowledge, show an increasing interest in what is probably India's greatest problem.

Among the topics considered are birth control, problems of sex, housing, vital statistics, infant mortality, the logistic law of population growth, optimum population, poverty, employment, nutrition, fertility, the primitive tribes, and marriage registration. Widely different views are expressed regarding the nature of the over-population problem in India, a few claiming that it does not exist. But most writers recognize that a serious problem needs to be faced without delay.

It is impossible to quote from such an extensive series of essays, but it may be worth while setting down a few of the relevant facts. In the 1931 census 73 per cent of the people lived by agriculture; yet with a population now probably 377 millions and an annual increase of 3·5 millions, the increase in rice production in the period 1910–35 is only 6 per cent and wheat shows a steady decline. The infant mortality is 232·6 per 1,000 and the maternal mortality 24·5 per 1,000, or six times that of England and Wales. The pressure of population is indicated by the statement that the average length of life has declined from 30 in 1881 to 23 in 1931. In every 1,000 persons, 10 are suffering from night-blindness, 6 from rickets and 4 from tuberculosis. It is claimed that India only produces 75–83 per cent of its food requirements in calories.

On the other hand, it is pointed out that there is differential fertility within the population as regards both classes and tribes. The 1931 census listed 25 million primitive peoples of many types, some of whom, such as the Todas, Kotas, Gonds, Bhils and Angami Nagas, have shown a marked decline in numbers. The process of transforming primitive tribes into Hindu castes goes on, but some of them at least continue to decline in numbers after being Hinduized. These tribes still constitute 8 per cent of the population of India.

It is clear that Indian politicians will find plenty of scope for their energies when they begin to consider seriously the vital problems of population and nutrition in India.

R. R. G.

*Indian Population Problems. Proceedings of the Second All-India Population and 1st Family Hygiene Conference. Edited by Prof. G. S. Ghurye. Karnatak Publishing House, Bombay.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PROFESSOR OF VETERINARY SURGERY, OBSTETRICS AND ANIMAL HUSBANDRY at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 30).

DEPUTY DIRECTOR OF EDUCATION—The Director of Education, Town Hall, Bradford (August 5).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

The Pioneer Health Centre, St. Mary's Road, Peckham, S.E.15. Report for 1938 and 1939. Pp. 48. (London: The Pioneer Health Centre.) [37

Llandudno, Colwyn Bay and District Field Club. A Supplement to the Proceedings. The Legend of Llys Helig: its Origin and its Significance. By Dr. F. J. North With an Appendix on the Archæological Aspect, by W. F. Grimes. Pp. v+67+8 plates. (Llandudno: Llandudno, Colwyn Bay and District Field Club.) 5*s*. [47

ASLIB War-Time Guides to British Sources of Specialised Information. No. 1: Fuel and Allied Interests (excluding Electricity). Pp. 18. (London: Association of Special Libraries and Information Bureaux.) 2*s*. 6*d*.; to Members, 2*s*. [47

University of London. Report of the Principal on the Work of the University during the Year 1939–40. Pp. 8. (London: University of London.) [47

The National Trust for Places of Historic Interest or Natural Beauty. Report 1939–1940. Pp. viii+128. (London: The National Trust.) [57

John Innes Leaflet No. 1: John Innes Composts for Pot Plants. Pp. 4. 3*d*. John Innes Leaflet No. 2: Soil Sterilisation for Pot Plants. Pp. 4. 3*d*. John Innes Leaflet No. 3: The John Innes Soil Sterilizer. Pp. 8. 6*d*. (London: John Innes Horticultural Institution.) [57

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 11, No. 4, March 1940. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+305–420. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [87

Other Countries

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 9: *Serphidæ* in Baltic Amber, with a Description of a New Living Genus, by Charles T. Brues; *Calliceratidæ* in Baltic Amber, by Charles T. Brues. Pp. 259–270. 35 cents. Vol. 73, No. 10: The Old World Species of the Celastraceous Genus *Microtropis* Wallich. By E. D. Merrill and F. L. Freeman. Pp. 271–310. 1.15 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [87

Occasional Papers of the California Academy of Sciences. No. 19: The Rabbits of California. By Robert T. Orr. Pp. iii+227 (10 plates). (San Francisco, Calif.: California Academy of Sciences.) [87

Field Museum of Natural History. Zoological Series, Vol. 24, No. 12: Notes on Texan Snakes of the Genus *Salvadora*. By Karl P. Schmidt. Pp. 143–150. 10 cents. Zoological Series, Vol. 24, No. 13: A New Toad from Western China. By Karl P. Schmidt and Ch'eng-Chao Liu. Pp. 151–154. 10 cents. (Chicago: Field Museum of Natural History.) [87

U.S. Department of Agriculture. Farmers' Bulletin No 1829: Insects and Diseases of the Pecan and their Control. By G. F. Morznette, C. B. Nickels, W. C. Pierce, T. L. Bissell, J. B. Demaree. J. R. Cole, H. E. Parson and John R. Large. Pp. ii+70. (Washington, D.C.: Government Printing Office.) 10 cents. [87

Transactions of the San Diego Society of Natural History. Vol. 9, No. 14a: A New Subspecies of the Western Worm Snake. By Laurence M. Klauber. Pp. 67–68. Vol. 9, No. 18: The Worm Snakes of the Genus *Leptotyphlops* in the United States and Northern Mexico. By Laurence M. Klauber. Pp. 87–162+plate 6. Vol. 9, No. 19: The Lyre Snakes (Genus *Trimorphodon*) of the United States. By Laurence M. Klauber. Pp. 163–194+plate 7. Vol. 9, No. 20: Two New Species of *Phyllorhynchus*, the Leaf-nosed Snake, with Notes on the Genus. By Laurence M. Klauber. Pp. 195–214+plate 8. (San Diego, Calif.: San Diego Society of Natural History.) [87

Refractories Investigations in Mellon Institute on the American Refractories Institute's Multiple Industrial Fellowship. Pp. iv+20. (Pittsburgh, Pa.: Mellon Institute.) [87

Catalogues, etc.

The Wild-Barfield Heat-Treatment Journal, Vol. 4, No. 25, June. Pp. 9+v. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue of Books and Journals on Zoology, Biology and Geology. (No. 576.) Pp. 70. (Cambridge: W. Heffer and Sons, Ltd.)

New Apparatus for the Laboratory. (Publication No. 368.) Pp. 16. (London: A. Gallenkamp and Co., Ltd.)

The Babcock Fuel Sampler. (GT.1306.) Pp. 2. (London: Griffin and Tatlock, Ltd.)

Carbachol B.D.H. Pp. 2. Leptazol B.D.H. Pp. 2. (London: The British Drug Houses, Ltd.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 3, 1940 No. 3692

POTENTIAL AND REAL SCIENTIFIC MAN-POWER

THE various reports which have already been issued by the Select Committee on National Expenditure have afforded encouraging evidence of a more scientific outlook in the prosecution of our war effort, though there is still room for improvement in attempts to get the maximum utilization of scientific knowledge and resources in the elaboration of policy and in its execution. The eighth of these reports, which comes from the sub-committee on Home Defence Services, deals with matters with which scientific workers are themselves directly concerned.

The first and major of these subjects is the Central Register, which originated as a part of the National Service campaign, the establishment and working of which are critically reviewed. The Register was compiled through the medium of the professional and technical institutions, which circularized their members with an appeal issued on behalf of the Minister of Labour and National Service. In addition, individual applications for enrolment on the technical section of the Register were examined by the committees, and the volunteers were enrolled if found suitably qualified. Applications for enrolment on the administrative and business management sections of the Register were examined by the Department on the basis of standards laid down by the Administration and Management Committee.

Altogether about 50,000 individual applications for enrolment in the Register have been examined since the outbreak of war, of which somewhat less than half have been accepted. On May 20, the live section of the Central Register contained 97,044 names, sorted into 75 main classifications and 735 sub-classifications.

The Central Register is thus an essential part of the organization of the national effort. The report emphasizes, however, that it is not, as is often supposed, an organization for finding jobs for men but for finding men for the jobs. There are still many people of the highest qualifications who appear not to have realized this and have failed to register. The recent order of the Minister of Labour and National Service regarding the compulsory registration of professional engineers, while an indication that registration of engineers is incomplete, is not to be taken as implying greater backwardness on their part than with other scientific and technical workers. It was the first and essential prelude to any considerable use by the Minister of Labour of his wide powers of transference and placing of labour of all kinds, whether professional or otherwise. The order is expected to add about 30,000 to the 20,000 names already appearing in the engineering categories of the Register.

The subsequent extension of compulsory registration to chemists, physicists and quantity surveyors shows that the Minister of Labour has lost little time in acting on the sub-committee's recommendation that complete, and therefore compulsory, registration of persons in categories which are, or are likely to become, scarcity categories of the Central Register is essential. No organization of priority is possible without this foundation.

The report's major criticisms are indeed in respect of this question of priority and of the use made of the Central Register. In regard to the first point, there has until recently been no effective machinery for determining labour priority. Obviously the ultimate decision whether to release a man or woman of the Central Register standard from his or her appointment can no longer be left with the employer. Compulsory registration is a first step to this end; but the report also points out that the effective placing of scientific or technical staff in industries subject to the Undertakings (Restriction on Engagement) Order, 1940, can be exercised through the Central Register better than through the local office.

Hitherto the main use of the Central Register has been by Government departments and by such bodies as Chatham House and the British Council. This position has led to the erroneous belief that the Central Register is intended to divert highly qualified persons into the Departments rather than into vital war and export industries. The declared object of the Register is to supply additional wartime needs, whether in Government departments or elsewhere, and the sub-committee's recommendations in regard to wider use of the Register are designed to ensure that it plays much more effectively its essential part in the organization of the war effort.

The report recommends accordingly that industrial undertakings under Government control should be immediately and strongly recommended to recruit technical and professional staff from the Central Register. It further recommends that the rule that Government departments should recruit temporary staff of Central Register standards solely through that Register should be strictly enforced, except where it is urgent that the post be filled immediately and where the post to be filled is of a character requiring special qualifications and for which there is a limited field of choice. Even in regard to the latter reservation, it may well be held that use of the Central Register is the more appropriate method, particularly if professional institutions, which in normal times maintain their own appointments bureaux for the benefit of qualified members, maintained sufficiently close contact with the Central Register.

The report undoubtedly implies that more whole-hearted support should be given to the Central Register by individual scientific workers and their professional associations. More specifically, however, it urges that Government departments should assist the Central Register to function more effectively by presenting their demands for technical staff through a technical rather than an establishment officer, to secure the more precise formulation of their requirements. Similarly it is recommended that they should not require full technical qualifications for posts which are primarily administrative, and that they should not be too rigid in their requirements in regard to age. Expediting the notification of appointments is also urged as facilitating the work of the Register.

The report also comments on the inadequate salaries frequently offered and on the absence of any provision for registering firms of technical consultants, who might be willing to work together as a team. Such teams, accustomed to work together and possessing varied qualifications and experience, would often be likely to be more effective than a technical section of a Government department built up piece-meal. The sub-committee strongly recommends the careful exploration of this source of technical and professional skill at present untapped by Government departments and industries in the war effort.

Obviously a number of these recommendations and suggestions, although addressed primarily to Government departments, merit equally careful consideration by industry if the Central Register is to make its full contribution to our war effort. Moreover, many individual scientific workers are themselves occupying positions of responsibility which enable them to implement such findings, and it may well be hoped that the appearance of this report will lead them to consider very closely the possibilities of thus implementing the co-ordination of our resources of scientific and technical knowledge and skill.

The observations of the report on the neglect of the Central Register of Aliens appear at a time when renewed attention has been directed to the use generally of the services and special knowledge of friendly aliens and refugees in our midst. Both in the Houses of Parliament and in the general Press, the general internment of aliens has received strong criticism even from those who are most fully alive to the necessity of the policy of internment as such.

The question has come into prominence from two points of view; first in view of its damaging effects on the war effort, and second, from its effect on opinion abroad, alike in providing material for enemy propaganda, in neglect to use those who could be of service to our own cause in that field, and as inconsistent with our traditions and the ideals for which we are fighting. It is, of course, with the first of these alone that the sub-committee's report is concerned.

The Central Register of Aliens has been compiled mainly through the medium of the Society for the Protection of Science and Learning and the refugee agencies dealing with professional classes. It is largely confined to the scarcity categories of the main Central Register. The qualifications of these aliens are carefully examined, with the assistance of the chairmen of committees, before they are enrolled. The aliens registered are either friendly aliens or, if enemy aliens, those remaining in Category C (exempted from all restrictions), where they have been placed by the Home Office tribunals.

The sub-committee was informed that, in general, resort is only had to the Aliens Section of the Central Register to fill those vacancies for which aliens would naturally be expected to be useful, or vacancies in scarcity categories The sub-committee is satisfied that this Register could perform useful service. It contains a wealth of valuable material, including names of international repute. Demands on this section of the Register should not be hindered merely by the failure to devise such safeguards as may be required on grounds of security.

The hope thus expressed by the sub-committee will be echoed by every scientific worker. As pointed out in a recent leading article (NATURE, 145, 796; 1940), any form of preferential treatment of alien scientific workers would carry with it a grave element of risk which could not be justified. While, however, general internment of alien men of science may have been necessary at the time it was carried out as a precautionary measure, neither in science nor in other fields have we such a superabundance of man-power or brains that we can neglect any source of assistance. This was visualized as a possibility in the same article in NATURE. Repeated instances have already been cited in Parliament and in the Press of the actual interruption of war-work through indiscriminate internment of friendly and anti-Nazi aliens, apart altogether from the refusal to accept offers of service from those only too eager to help.

There is little reason to doubt that the actual conditions in the internment camps will speedily be improved, but beyond this a definite aliens' policy is wanted, the absence of which is largely responsible for the worst mistakes or abuses. An aliens' board or commission under a responsible minister is required to supervise the whole problem, look after the welfare of aliens, examine and re-examine their credentials, and use to the full the abilities of those it finds trustworthy. Such an authority might well have prevented the scandals of recent weeks. It should prove the most effective means of implementing the recommendation of the report of the Select Committee and making available for the war effort here and in the overseas Empire the skill, knowledge and good will of many whose services are at present denied to us only by our own policy.

The vigour with which the Minister of Labour and National Service has already acted on other recommendations of the Select Committee, no less than the terms of the appeal addressed to the management of all the 9,000 firms working for the Government by the First Lord of the Admiralty, the Minister of Supply, and the Minister of Aircraft Production, will encourage the hope that this matter will not be overlooked. Sir John Anderson has now announced in the House of Commons on July 23, among other important changes in the treatment of enemy aliens, the formation of a small advisory committee to assist him in considering the question of enlarging the categories of exemption to include particularly those who could render services of special value or make a significant contribution to the war effort. This, with the transfer to the Home Office of the responsibility for managing internment camps, should go far to facilitate the rectification of mistakes, and the new policy has already been warmly welcomed.

Rapid progress should now be made in releasing those who have been wrongfully interned and in making life tolerable for those still confined. At the same time the new policy will still exclude numbers of potential workers, bitterly opposed to Hitler, and wholly on our side, against whom there is no reproach or suspicion. If the most urgent task is that of utilizing the specialist services as fully and quickly as possible, the traditions of Great Britain, and it may well be its ultimate security, will not permit us to rest content with any policy which does not avail itself to the maximum extent of the good will and services at our disposal.

The utilization of the willing services, which we ourselves urgently need, and which are only too anxious to be enrolled, means far more than the mere material accession to our war effort implied. Failure to evolve the necessary safeguards demanded would augur ill for our capacity to embark on the much larger task of establishing a new world order after the war. Integration of such services, skill and knowledge into our effort, on the other hand, will testify to a freedom from hysteria, a capacity for competent organization, and to a loyalty to the ideals and traditions of humanity worthy of the cause for which we contend.

ANIMAL COLORATION AND NATURAL SELECTION

Adaptive Coloration in Animals
By Dr. Hugh B. Cott. Pp. xxxii + 508 + 49 plates. (London: Methuen and Co., Ltd., 1940.) 40*s*. net.

THIS excellent work, eagerly awaited for many years, will be most welcome to naturalists, even, we may hope, to the few who have hitherto rejected the Darwinian interpretation which the author has here supported by a mass of additional evidence based on his own observations and those of very many others. Dr. Julian Huxley, in his introduction, refers to one of these critics, the American zoologist, A. F. Shull, who writes in contemptuous terms of the whole subject. To this Huxley replies: "Dr. Cott, in this important book, has turned the tables with a vengeance on objectors of this type. He has shown that it is they who are the armchair critics, or, one might say, the laboratory-bench critics. Had they taken the trouble to acquaint themselves with even a fraction of the relevant facts to be found in nature, they could never have ventured to enunciate such sweeping criticisms".

"Adaptive Coloration", following the author's preface, is divided into three parts: (1) concealment; (2) advertisement; (3) disguise, including mimicry (in cuckoos as well as insects and the relations between the two forms of resemblance); finally, a brief conclusion in which the cumulative effect of the facts and arguments is shown to "present a body of evidence which makes it appear that adaptive coloration is one of the chief attributes of the higher animals, and has been, indeed, one of the main achievements of organic evolution" (p. 427).

The immense amount of labour devoted to the production of this great work may be inferred from the 685 titles of original memoirs quoted in the bibliography (pp. 439–66). A brief inspection of the list will at once show how much we owe to the author for bringing together and discussing these scattered records of observations on adaptive coloration in animals and for their certain result, the stimulation of further researches along the same lines as well as others which are sure to be developed as the work proceeds. Special mention must be made of the illustrations. The coloured frontispiece, by the author, exhibits the warning coloration of eight Amphibia, while forty-eight monotone plates, chiefly reproduced from his admirable photographs of living species at rest in their natural surroundings, and eighty-four text illustrations, supply the help which is so absolutely necessary in this subject. Prof. Hale Carpenter, in a recent review, has referred to "the scattering of the plates at random through the pages" and the inconvenience of the references to some of them. I, too, felt something of a shock, in reading the extremely interesting pages on crabs and the stinging sea anemones, their welcome and invaluable guests, to be suddenly faced by the lovely plate 30 (opposite p. 236), displaying an East African hawk-moth at rest on a tree trunk at Beira. There can be no doubt that a second edition will soon be required, and we may hope that the arrangement of plates and the references to them will then be improved.

In the limited space available it is impossible to treat adequately the first and much the longest of the three sections into which the book is divided, namely, concealment. I must, however, direct special attention to the admirable and abundant plates and text figures and the excellent account of the whole subject and each of the ten heads into which it is divided, as clearly shown in the table of contents.

On the subject of Part 2, advertisement—aposematic or warning colours—I believe that every open-minded reader of pages 191–233, devoted, with the accompanying plates and figures, to the methods by which different animals are rendered conspicuous in Nature, will agree with the author's statement that the classes of evidence "all point to the conclusion that *aposematic appearances are adaptive*: that they tend to satisfy a vital need in the struggle for life, *the need for recognition by predatory enemies as something unwholesome, something unwelcome, and something to be avoided*" (p. 233).

The succeeding section, on adventitious warning coloration (pp. 234–44), describes many examples of "relatively defenceless and palatable animals . . . known habitually to associate themselves with others which are specially protected and conspicuous, and thus to share the protection from enemies which the latter enjoy" (p. 234). Instances of such partnership between crustaceans and sea-anemones or other unpalatable forms were recorded long ago—an interesting British example by P. H. Gosse in June 1859 and several observed by Walter Garstang at Plymouth, a few years later. Extremely interesting and remarkable as these and other early records certainly are, I do not remember meeting with any criticism or doubt of an interpretation based on adaptation which was, I believe, offered by every observer. But the facts and their interpretation are so significant, and indeed arresting, that the admirable section in which the subject is brought up to date gave me special satisfaction and I hope it will be widely read, especially by those who are inclined to be critical of natural selection. A few of the many examples quoted by the author may be mentioned :

"The coral-haunting crab *Melia tessellata*, from Mauritius, invariably grasps two anemones, one in each claw—employing them both for defence and for feeding. Borradaile states that if the crab is assailed it thrusts the polyps towards the enemy and thus wards him off with their stinging tentacles, but if the polyps capture food, the crab takes the morsel from their grasp with one of its legs and transfers it to its own mouth" (p. 235). Other examples quoted are the damsel-fishes (Pomacentridæ) of the Indo-Australian Islands, which find protection among the stinging tentacles of certain large anemones and apart from these are unable to withstand the attacks of more active fishes (pp. 237–38).

Immediately following the account of associations observed in the life of the sea is a description of the nesting partnerships between birds and aggressive Hymenopterous insects, such as wasps, which Dr. J. G. Myers has carefully studied in South America and the West Indies (pp. 238–39). Dr. Cott concludes that the evidence as a whole "indicates that we have in these forest-dwellers a highly perfect and singular instinct correlated with the need for protection from enemies" and that it has its parallel "in the waters of coral reefs, where stinging anemones, rather than stinging aculeates, play the role of protector to the defenceless creatures who solicit their company" (pp. 239–40).

Dr. Cott has lightened and brightened his book by numerous admirably chosen quotations introduced into the text or appearing as headings to sections. Thus, referring in the preface (p. xiii) to the function of camouflage in aerial warfare, he points out that "we have lagged far behind nature, and have much leeway to make up before we can approach the efficiency attained by different forms of wild life in the field. We should do well, therefore, to follow advice from the Book of Job : 'But ask now the beasts, and they shall teach thee ; and the fowls of the air, and they shall tell thee . . . and the fishes of the sea shall declare unto thee' ". Another attractive and appropriate quotation, from Milton, supplies the heading (p. 290) to Section 9 : "Evidence of selective feeding by vertebrate enemies in a state of nature", containing abundant proof that the diet of many insectivorous animals is determined by palatability rather than availability, as some critics have urged. In the quotation the Archangel Raphael speaks to Adam of the "various living creatures" of the earth and air, and asks him :

"Know'st thou not
Their language and their ways ? They also know,
And reason not contemptibly."

It has been a very great pleasure to read Dr. Cott's fine work, to remember that it has been produced in this, the country of Charles Darwin, and that many excellent observations made in happier times by our present enemies are here described. May such happiness soon return !

E. B. Poulton.

WATER AND ALL ITS PROPERTIES

Properties of Ordinary Water-Substance in all its Phases
Water-vapor, Water and all the Ices. Compiled by N. Ernest Dorsey. (American Chemical Society, Monograph Series No. 81.) Pp. xxiv+ 673. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1940.) 90*s*. net.

In this very remarkable book, Dr. Dorsey presents a series of nearly three hundred tables on the principal physical properties of water. The book continues the work commenced when the author was an associate editor of the International Critical Tables, for which he worked indefatigably. It is based, in respect of data obtained before 1923, mainly on these Tables ; for more recent data, the literature has been exhaustively searched, much more than a thousand references being given, and good use has been made of other tables and monographs. The breadth of knowledge and the conscientiousness with which this enormous mass of data has been digested and put into perspective compel profound respect.

All the ordinary physical properties of water are of course fully tabulated, for ice, water, and steam. Thermodynamic properties are fully given, including the data for the synthesis of water from its elements and for its dissociation. There are full tables of the spectroscopic and other optical properties, also of the magnetic, magneto-optic, dielectric, and acoustic data. The results of the X-ray examination of ice and water are summarized and the sections on surface properties, as would be expected from the author's earlier contributions to the subject, are very good.

Much information that is not capable of quantitative tabulation is also given. There are excellent descriptions of the entrancing phenomena accompanying the formation of ice; indeed this book excels in its account of the various properties of ice, and of their importance in many directions, including meteorology and engineering. There are a few short sections dealing with miscellaneous topics, such as the preparation of dust-free water, and the composition of sea water. The term 'water-substance' means water as found on the earth, that is, having the usual isotopic ratio of about one part in 6,500 of deuterium oxide; but a good deal of information is included on sea water, in various places in the book. The solubility of gases in water, and the diffusion of gases through such solutions, are discussed; but wisely the solvent power of water for other substances is not treated.

This book is a monumental piece of industry, guided and inspired by learning and a breadth of interest far beyond that of most scientific authors. Naturally it is not a book to read through, though many parts of it are surprisingly readable. It should be on the shelves of every well-equipped library, where it will be consulted by workers in almost every branch of science. It provides, immediately, data of sufficient completeness and authority for all but very highly specialized work; and even those intending to pursue any special part of the subject farther than it is taken here will find this book an admirable and extremely well-balanced introduction.

N. K. Adam.

HISTORY OF THE POWER STATION INDUSTRY

The Early Days of the Power Station Industry
By R. H. Parsons. Pp. x + 218 + 24 plates. (Cambridge: At the University Press, 1940.) 15*s*. net.

THE author says in his preface that so rapid has been the growth of the industry and so profound the changes it has undergone, that few of its original features are now recognizable. He has done well to give an account of electricity supply as it was in the days when every enterprise was largely of a pioneering nature and its future could only be guessed at. This period closed near the end of last century. At that time the lines along which progress would take place were becoming evident.

The birth of the power station industry was foreshadowed by Faraday's discovery, in 1831, that electricity could be generated by mechanical means. The author points out that we may say that the development of the dynamo in its present form started in 1845, when Wheatstone and Cooke patented the use of electro-magnets in place of permanent magnets for the field. Machines were not made completely self-exciting before 1866, when the brothers C. and S. A. Varley, Dr. Werner Siemens and Sir Charles Wheatstone independently and practically simultaneously, discovered the principle of self-excitation. The production by Gramme, in 1870, of a dynamo with a ring-wound armature brought matters to a point when the industrial generation of electricity really became a practical question.

The first company to be formed for the exploitation of electric machinery was probably La Société Générale d'Electricité, of Paris. It was founded in 1853 to develop a machine designed by Prof. Mollet for the purpose of generating current for the electrolysis of water. The object was to produce hydrogen and oxygen for making limelight. The project was not successful, but the machine was modified by Prof. F. H. Holmes and used for experiments in connexion with electric light. On December 8, 1857, the light produced by his second machine was thrown over the sea from the South Foreland Lighthouse.

Sir Humphry Davy showed in 1808 to the Royal Institution that a brilliant light could be produced by allowing an electric current to form an arc between a pair of carbon points, the current being obtained from a battery of 2,000 zinc-copper cells. For illumination, arc-lighting was the only way of utilizing electricity. In August 1878 six Lontin lamps were employed to illuminate the Gaiety Theatre; this was the first building in London to be lighted electrically. It was installed by French engineers.

The discovery of incandescent lamps by Edison and Swan and their wise agreement to amalgamate their interests in October 1883, so as to avoid litigation, was a great advance. If we confine ourselves to undertakings that have a continuous existence to the present time, the honour of priority should be given to that of Brighton. The history of the Brighton undertaking can be traced back to December 1881, when Robert Hammond went to Brighton and staged an exhibition of the Brush arc-lighting system. The response was so good that the Hammond Co. gave a permanent supply of sixteen arc lamps in series carried on an experimental circuit for nearly two miles.

On looking through the book, one is struck by the versatility of many of the great pioneers of the mechanical and electrical power industries. Among others, we may mention Colonel Crompton, born in 1845, a world pioneer of D.C. dynamos directly coupled to high-speed Willans engines, and Sebastian Z. de Ferranti (1864–1930), who designed the high-voltage A.C. generating station at Deptford. He was the world pioneer of high-voltage transmission.

One of the greatest engineers was Charles A. Parsons, whose name is well known as the inventor of the steam turbine. The results of his efforts to provide the electrical industry with a better prime mover and dynamo, was the invention of the turbo-generator. The first machine of this type was constructed by him in 1884, and it now has an honoured resting place in the Science Museum at South Kensington. The fertility of Parsons as an inventor is shown by his list of British patents, which number more than three hundred. He founded several large engineering works. His invention of the steam turbine has made it possible for electricity to become almost a necessity of industrial and universal welfare, instead of a costly luxury.

This volume will be of great interest to every engineer. It contains a large number of excellent photographic reproductions of early power stations. the facts are well authenticated and the interest never flags.

A. RUSSELL.

THE DRIFT FROM THE LAND

Proceedings of the Fifth International Conference of Agricultural Economists, held at Macdonald College, Canada, 21 August to 28 August 1938.
Pp. xiv + 436. (London: Oxford University Press, 1939.) 17*s*. 6*d*. net.

A STEADY decline in the agricultural population of every industrialized country is one of the most characteristic features of the present stage of civilization. The grave social consequences, if the decline continues, have frequently been portrayed, and some of them have already been experienced—even in countries which, like the United States, still have larger rural populations than can be accommodated under the prevailing economic system; for the decline is not only in numbers, but also in the strength of the bonds which tie the cultivators to the land. The cultivators are not so deeply rooted in the soil as formerly, and at any time an economic blast may blow them away.

The problem of the drift from the land is engaging the attention of sociologists and economists throughout Europe and North America. The solutions proposed to stem the drift do not include the return of sociologists and economists to the agricultural labours of their forefathers, and the recent failure of schemes for settling equally unsuitable material in the form of industrial unemployed on the land is leading to the abandonment of large schemes of rural resettlement. It is proposed, instead, to check the rural exodus by alleviating the lot of the dwindling minority which still remains tied to the soil—by substituting economic persuasion for the grim struggle for existence that Nature imposes on those who must sustain her challenge and hold the land for the use of mankind. There is, however, nothing in history to show that alleviating conditions for the front-line defenders of civilization either strengthens the defence against, or weakens the attack of, the antagonist who is always waiting to re-occupy the soil. But it is felt that something must be done to encourage the defenders, and it is up to those in the rear to do it.

In one form or another this problem was present in the minds of most of the speakers at the Fifth International Conference of Agricultural Economists. The four main sessions of the Conference discussed the social implications of economic progress in present-day agriculture; land tenure and social control of the use of land; farm labour and social standards; and international trade in relation to agricultural development. A dominant note in the Proceedings is struck by a widespread realization that the economic and political impacts of civilization are causing mankind to lose contact with the soil. A very high standard was maintained throughout the discussions, and it would be invidious to select any of the seventy-odd contributions for particular mention.

Agriculture has lagged behind in the rapid economic development which industry has undergone in the last century. Industry is now a corporate affair whereas agriculture is still largely individual, and many of the economic strains to which agriculture is now subjected throughout the world may be traced to the inability of the individual to hold his own against the corporation. If this be so, the remedy would appear to lie in some form of co-operative agricultural organization, either voluntary or enforced by the State. Such organization has, indeed, already saved the farming community from complete economic ruin by industry in many countries, but in so far as the farmer abandons his individualism he loosens one of his most valuable contacts with the land—most valuable, that is, from the point of view of the society he supports. The farming community forms a biological link between the land and the otherwise detached industrialized societies living in sublime ignorance of the soil and of the latent power of Nature to eject them from it. As the link weakens, either by a bodily or a spiritual drift from the land, the delicately balanced superstructure of industrialized society begins to totter, and economists, sociologists and politicians bestir themselves to restore the equilibrium while there is still time.

We can observe them at work all around us to-day, the economists explaining the causes and seeking the cure for the small material reward the cultivator gets for his labours ; the sociologists lauding the rigorous life of the countryside ; the politicians currying the once neglected favours of the agricultural community. Earnestly they strive to distribute more equitably the burden of supporting civilization between the superstructure and the foundations. The farmer is to be assured a fair market and price for his produce ; housing, sanitation, education, conditions of work and of leisure are to be improved ; the rival attractions of the town are to be brought to the countryside ; the countryman is encouraged to multiply his kind. If these economic and social measures fail to stem the drift from the land, political pressure can be brought to bear—as in Germany, where the recent *Erbhofsrecht* restricts the right of the peasant to alienate his land or to disinherit his son.

Nevertheless, it is noteworthy that in several countries within the last twenty years a marked improvement in the conditions of agricultural labour and in the amenities of country life has been accompanied by an accelerated drift from the land. The drift has been as strong in Germany, where men have thought, written and acted against it, as it has been in Britain, where men have thought—and occasionally written—about it, or in the United States where, until a few years ago, the individual farmer was left defenceless against the economic holocaust of the agricultural depression of the nineteen-thirties. It seems as though the economic and social antidotes which have been applied to the country have been taken in still greater measure by the towns, and the attraction exerted by the latter has increased rather than diminished. That, at least, is an impression one receives from the Proceedings of this economic conference, which was more concerned with elucidating the intricacies of the problem than with the superhuman task of formulating a solution.

The solution—if any—has, indeed, little or no relation to economics. America has a greater rural population than the land can profitably employ ; but it is not suggested that her rural troubles—and especially her main trouble of erosion which aggravates all others—would be alleviated by a depletion of the rural population sufficient to give the remainder a satisfying share of the wealth of the soil. The trouble lies much deeper than economics. The farmer has no particular value to the community—except as a food producer, and machines can perform most food-producing functions equally well—unless he is tied by a spiritual bond to the land, a bond which is strengthened by making life not easier, but more difficult for him. The bond is the struggle with Nature for mastery over the land. When man's mastery over the land has been secured, as it has been in most countries of Western Europe, it is questionable whether any economic or social measures will suffice to prevent those who can from escaping from the slavery of the land, and enjoying some of the fruits of man's victory and the physical satisfaction of eating bread won in the sweat of another's face. Indeed, it is questionable whether in these circumstances an artificially maintained rural population has a social, or, under modern conditions of warfare, even a military value which is not possessed equally by an urban population. The love and understanding of the land characteristic of the cultivator while the issue of the struggle with Nature is still uncertain are liable to turn to indifference when men must be induced by what practically amounts to bribery to keep their roots in the soil. They probably will not stay on the land without inducement, but if they are induced to stay their chief value to the community at large is that they do not increase the congestion in the towns. Their social value as a stabilizing factor, and their biological or spiritual value as a link between civilization and the rest of Nature are largely lost.

The bond with Nature, once broken, can only be mended by losing ground already won and then attempting to recover it. It is improbable that any people which has fought and won its battle will willingly retreat in order to fight again. The peoples of Western Europe hold their lands securely against the forests they have supplanted, and only a few men are now needed to protect the strong defences that have been erected against wild Nature. The bodily drift from the land may be stemmed, but the spiritual drift will go on. There is no longer any biological restraint to bind the great majority of men to the soil, and economic remedies are no substitute for the harsh bond of biological necessity that is now lacking. The pain and travail, the wind and rain in the fields, which are the essence of Nature's bond, are not for the economists and sociologists nor—if they can be avoided—for anybody else.

In America, on the other hand, the recently vaunted conquest of Nature by technocracy has been shown to be unreal. Desolation and destruction of the land have forced a retreat which can only be reversed by a people deeply rooted in the soil. The present drift from the land must be stopped and a spiritual bond forged between man and Nature. But the bond will be forged not by lightening the hard lot of the farmer, nor by otherwise encouraging a shallow-rooting human cover on the land, but by an unremitting struggle against the natural forces of adversity that mankind has released upon itself. Those forces are of biological and physical origin, and can be overcome—and the enduring fertility of the soil assured—only by biological and physical effort. The economics of the struggle with, and of the victory over, Nature are of great practical importance, particularly in these critical times, but they are not fundamental to the ultimate issue.

G. V. JACKS.

STUDIES IN MICROBIOLOGY

A Textbook of Microbiology

By Prof. Kenneth L. Burdon. Second edition of "A Textbook of Bacteriology". Pp. xv + 638. (New York: The Macmillan Company, 1939.) 14*s*. net.

SO far from being a text-book on general microbiology, as the title seems to imply, more than half this book is devoted to the medical aspects of the subject, little space being assigned to fermentation, soil microbiology and nitrification, micro-organisms in industry, and the like.

In the earlier portion of the book, some 150 pages, the fundamentals of microbiology are dealt with at some length, and an excellent account is given of the general properties and classification of micro-organisms, with chapters on the Protozoa, fungi and moulds, spirochætes and viruses, and the true bacteria. Part 2 is devoted to the laboratory study of micro-organisms—the microscope, culture media and culture methods, and isolation, with a section on disinfection. Under viruses and filterable micro-organisms, no explanation is given of the reason for their invisibility microscopically.

The remainder of the book gives an account of the relation of micro-organisms to disease, commencing with the sources and prevention of infection and aseptic technique. Chapters follow on resistance and immunity, anaphylaxis, and the practical use of vaccines and serums. Lastly, the microbiology of the chief infective diseases is considered. The treatment here is on somewhat novel lines, for the individual diseases are dealt with from the point of view of the regions of the body principally affected, the natural microbial flora of the region and the pathological conditions affecting the part being first considered, after which the micro-organisms responsible for these conditions, or likely to be present, are described.

The descriptions given throughout are clear and accurate and well up to date, and the treatment of the subject takes a middle course between an elementary text-book and an advanced treatise. We gather that the book has been designed as a general college course on the subject, rather than for the student of medicine and hygiene, and while serving as a useful outline for the medical student, it is scarcely full enough in many sections to be his only guide. As in many American textbooks, review questions are appended to the various chapters, and the book concludes with appendixes on bibliography, formulæ, and suggested laboratory exercises.

The book is very readable and free from mistakes, is well produced and illustrated, and some portraits of pioneers of the subject add to its attractiveness.

R. T. HEWLETT.

The Physics of the Divining Rod

Being an Account of an Experimental Investigation of Water and Mineral Divining. By J. Cecil Maby and T. Bedford Franklin. Pp. xv+452+6 plates. (London: G. Bell and Sons, Ltd., 1939.) 21*s*. net.

THIS is a very ambitious book: its aim is to provide a much-needed physical explanation of dowsing and to improve its technique on scientific lines and, at the same time, to present a coherent mathematical theory. The greater part of the book is written by the first author and surveys the whole field of former investigations, describing many others made by himself and his co-workers. In his survey Mr. Maby shows a very uncritical acceptance of a number of claims either very insecurely established or already discredited. This has an unfortunate effect on the scientific reviewer, and his confidence is not increased by finding that there is not a graph containing points which indicate actual observations: all are smoothed means and consequently their value cannot be assessed. Measurements with Wynn-Williams ionization counters are described but not in sufficient detail to make critical comment possible. Atmospheric ionization is not an easy subject experimentally.

The theoretical section, by the second author, postulates some form of cosmic radiation resulting in electromagnetic waves of ten metres wave-length. There seems to be no direct evidence for such waves, and the author's discussion of their polarization cannot be justified on our present physical knowledge.

In presenting facts and theories to the scientific world, there is a well-accepted and necessary procedure. It is to be regretted that the authors have not followed this procedure, thus making the position of the scientific reviewer impossible.

Fossil Orthoptera Ensifera

By Frederick Eberhard Zeuner. Text. Pp. xiii+321. 15*s*. Plates. Pp. iv+80. 20*s*. (London: British Museum (Natural History), 1939.)

DR. ZEUNER has written a monograph which transcends the immediate purpose of a British Museum catalogue. He has made a study of fossil Orthoptera and allied insects side by side with the recent species and, in this way, he has enabled the reconstruction with reasonable probability of the evolution of the group Ensifera. This latter assemblage includes the Tettigoniidæ, or long-horned grasshoppers, the Gryllidæ, or crickets, together with various allied families. It is shown that the Ensifera may be traced back into Upper Carboniferous rocks. Their ancestors were Protorthoptera and are closely related to those of the Acridian group or short-horned grasshoppers.

Dr. Zeuner is an expert at his task and, unlike some insect palæontologists, he has the knowledge necessary to combine the evidence derived from recent and fossil forms to good purpose. Passing over the purely technical descriptions of genera and species, the premises upon which the main conclusions are based form interesting and instructive reading. The author's accounts of the venation and of the sound-receptor organs, for example, have involved a large amount of independent investigation the results of which aid in solving the phylogeny of the insects concerned. We hope that the British Museum (Natural History) will see its way in future to publish more monographs, of larger or smaller groups, involving, like the present work, conclusions of fundamental importance to our understanding of their origins and affinities.

Buschi

Vom Orang-Säugling zum Backenwülster. Von Prof. Dr. G. Brandes. Pp. v+135. (Leipzig: Quelle und Meyer, 1939.) 4.80 gold marks.

"BUSCHI" is a somewhat discursive account of the growth of a celebrated male orang-utan belonging to the Dresden Zoological Gardens, to which it went when an infant a few weeks old, and where it is apparently still living, a mature and powerful ape enjoying, judging by its photographs, even less in the way of good looks than is normally possessed by orangs. Records are given of the animal's increasing weight, of the times of eruption of its teeth, of its sexual maturation, and its development of secondary sexual characters; much of this information is of considerable interest to students of human evolution. Dr. Brandes has also gone to great trouble in acquainting himself with, and in illustrating, the individual characteristics of other captive orangs, and his observations on the great variability of this species of ape are not without interest in relation to the general question of racial differentiation, and in particular with the more specific question of the existence or non-existence of races among orangs. The book is lavishly illustrated, but it has no bibliography.

Monograph of the South American Weevils of the Genus Conotrachelus

By Karl Fiedler. Pp. iv+365. (London: British Museum (Natural History), 1940.) 15*s*.

THIS work, the text of which is written in German, deals with a single genus of weevils that is extremely numerous in species. It is entirely devoted to descriptions of the South American members and the majority of these refer to new species. The genus includes a number of forms that are pests of cacao, custard apple, guava, together with certain Leguminosae and such fruits as plums, apricots, etc. The monograph is illustrated by one plate and various text figures.

Statistical Method from the Viewpoint of Quality Control

By Dr. Walter A. Shewhart, with the editorial assistance of Dr. W. Edwards Deming. Pp. x+156. (Washington, D.C.: Graduate School, Department of Agriculture, 1939.)

FOR many years Dr. Shewhart has concerned himself with the development of statistical methods in the practical business of quality control in mass production. This latest publication covers old ground and provides a didactic foundation rather than any new extensions of his previous ideas. R. A. F.

CO-OPERATIVE AGRICULTURAL RESEARCH IN THE AMERICAS*

By the Hon. Henry A. Wallace,
United States Secretary of Agriculture

THE Governments of the American countries look to men of science, on one hand, for sound appraisals of their hemisphere resources and, on the other, for scientifically sound judgments as to the methods under which these resources can best be utilized in order to promote the general welfare and raise the standard of living of all American peoples.

In this connexion, special emphasis must be placed on agriculture for a number of reasons. One is that agriculture plays a very vital part in the economies of all the countries of the Western Hemisphere, especially those of Latin America. Another is that at present these countries produce much the same types of agricultural commodities. A third reason lies in the fact that export trade is vital to the welfare of these countries, and it so happens that agricultural items represent very significant portions of either the export or the import trade of each of them.

As things stand to-day, the lines of production in the Americas and the nature of the merchandise exchanged between the republics present definite handicaps to a substantial trade expansion. This emphasizes the need of exploring the possibilities for greater agricultural production in Latin America of tropical or semi-tropical products that the United States needs and can readily import in substantial quantities. Developing agricultural production along these lines would provide a sound basis for complementary trade relations and place the trade between the two areas on a solid foundation. As a consequence, it would increase the buying power of Latin American countries for the wide variety of products that they want from the United States but which, in present circumstances, they are unable to buy here. Finally, the development and expansion of production of complementary, non-competitive products would furnish the spearhead of co-operative efforts designed to give practical significance to the idea of Pan-American solidarity.

The tropical and semi-tropical products include such articles as rubber, cinchona, abaca, kapok, rotenone, and other insecticides, tea, cocoa, camphor, and tropical hardwoods. Hundreds of millions of dollars are spent by the United States each year for such commodities as these, imported for the most part from distant areas outside of the Western Hemisphere. Experiments and investigations already undertaken by private concerns and under co-operative arrangements of American Governments have revealed some encouraging possibilities by way of developing profitable production in tropical areas of Latin America. Recently the United States have co-operated in four important agricultural surveys in Haiti, Paraguay, Ecuador, and Colombia at the request of their Governments. Members of the United States Department of Agriculture who made the surveys gained a knowledge both of the problems and possibilities in Western Hemisphere agriculture. Their experience should be most helpful in work on the specific projects that must be undertaken in the future.

In this connexion, it has been found that some limited facilities exist in the Americas for research in tropical agriculture. But, for a long-term programme that would call for continuing research designed, on one hand, to develop and promote tropical agriculture on a scientific basis, and on the other hand, to train the agricultural leaders of the future in this field, more adequate facilities than now exist are indispensable. For such a purpose some thought has been given to the possibility of establishing an institute of tropical agriculture in some Latin American country where facilities for tropical research are suitable.

It is our sincere belief that the establishment of an institute of tropical agriculture is vital if Western Hemisphere agriculture is to develop as it should. This proposal, which we in the Department of Agriculture have been considering for a couple of years, has been endorsed by President Roosevelt's Interdepartmental Committee on Co-operation with the American Republics. The Institute would serve as a symbol of amity and of the economic and cultural relations between the Americas. It would lead to a better balanced agricultural economy in the Western Hemisphere. It would be in a position to present comprehensive data on the vital agricultural problems of all the American republics. It would develop a broad knowledge of pests and diseases common to the great tropical region. In bringing together students in agricultural science, it would promote a mutual understanding between these future leaders in agriculture. Through co-operative research it would work towards the solution of serious problems in crop and animal production such as the Sigatoka disease of banana, witch broom and Monilia rot of cacao, and animal parasites.

---

* Substance of a paper prepared for delivery at the session devoted to agriculture and conservation, Eighth American Scientific Congress, on May 11.

The Institute would not only provide technical training but also an opportunity to acquire a knowledge of the languages and the varied business methods, standards of ethics, and points of view of the Western Hemisphere.

Research on rubber production should meet with the approval of all those interested in or responsible for Western Hemisphere policies. Rubber is the most important of all tropical agricultural products. Although indigenous to South America, rubber is not grown there commercially to any extent. Indications are, however, that it could be and should be an important product of this hemisphere. The Goodyear Company, with its plantings in Costa Rica and Panama, and the Ford Company, with its plantings in the Amazon region of Brazil, have been pioneers in the plantation-production of rubber here. Research should be undertaken on modern production methods, such as soil management and the developing of high-yielding disease- and insect-resistant strains which can be used in bud-grafting. Such research would doubtless lead to the economical production of rubber.

It is our feeling that an institute of tropical agriculture cannot be established unless, in the beginning at least, the bulk of the necessary funds are subscribed by private foundations or individuals. Governments of the American Republics could participate directly by sending students to study in the Institute, assigning problems to the Institute for solution and perhaps furnishing part of the faculty. The problems assigned to the Institute would be of a kind that Governments would find it cheaper to pass on to the Institute for solution. The Institute, of course, would be equipped to work on large and important agricultural problems, at less cost and with greater certainty of solution than elsewhere.

Discussions of the Institute always bring up the question of location. It is our feeling that it should be located in a Latin American Republic under good environmental living conditions ; but, at the same time, be so situated as to be easily accessible to places having conditions favourable for the development of tropical crops like rubber, abaca and vegetable oils. Some Governments have indicated a desire to have such an institute in their countries, and a willingness to furnish sites for its location.

The fusing of agriculture and conservation in this section of the Eighth American Scientific Congress is entirely logical. If, in its truest sense, agriculture means the science and art of wresting vital human needs from the soil and the resources dependent upon it, it is essential that we should think simultaneously of conservation. Agriculture and conservation must progress hand in hand. The former could not long exist without the latter. The Americas have resources yet untapped.

Having gone through a long period of exploitation, coincident with settlement of the continent, we in the United States are now striving to reverse the trend and move as rapidly as we can toward the conservation of our resources in order to ensure sustained use. Conservation of natural resources is the pronounced policy of our Congress, and the executive branches of Government, in co-operation with individuals, co-operative groups, and corporations, are carrying on constructive programmes in this direction.

In undertaking to protect our natural resources for permanently sustained use, however, we promptly discovered several formidable gaps in our knowledge. We were aware, for example, that soil erosion was wasting our soil and its fertility at an incredibly rapid rate. But we had no precise knowledge of the extent of erosion in our country, and we had no extensive knowledge of the varying rates of erosion on different types of soil and under varying kinds of ground cover.

In recent years we have devoted an increasing amount of time and energy to gathering basic facts about our agricultural plants. This kind of inventory, in my opinion, is indispensable to the intelligent. conduct of agricultural programmes. How can we hope to conserve our resources for the continuous use and maximum long-time benefit of our citizens unless we know what resources we have, as well as their quality and quantity ?

In 1934, we made a reconnaissance to find out just how extensive and severe erosion of the soil had become in the United States. We learned that much of the land of the United States had been damaged to some extent and that not a single State had escaped. We learned that great areas had been ruined or severely impoverished. We learned where erosion is most severe, the types of erosion that had caused the most damage, and got some idea of the relative effectiveness of our major crops in protecting the soil or exposing it to the elements.

In the Americas, I believe, we have an obligation to ourselves and to the world. It is to develop our resources for the maximum benefit of mankind, yet, while developing them, to ensure to posterity their prolonged usefulness. Depending on our choice, we can exploit our resources, exhausting them completely, or we can draw steadily on them as requirements demand, preserving the source for future generations.

STRUCTURE AND COMPOSITION OF PLANT CELL MEMBRANES

BY WANDA K. FARR,
DIRECTOR, CELLULOSE LABORATORY, BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH,
YONKERS, NEW YORK

HISTORICAL CONCEPTION OF MEMBRANE COMPOSITION

THE complex structure and chemical composition of plant cell membranes were indicated in the reports of the earliest study of cells as biological units. Before 1850 the work of Payen[1] had shown that different proportions of carbon, hydrogen, and oxygen were obtained from some of the separable membrane constituents. During succeeding years, considerable progress was made in correlating chemical analyses with observed microscopic structural features of various types of membranes.

The observations of these early botanists and chemists were carefully reviewed by Mangin[2] in his memoirs on the pectic compounds published in 1891–92. A constituent, almost universally present in plant cell membranes, which was very resistant to ordinary chemical and physical treatment, they had named 'cellulose'. From the point of view of orderly molecular arrangement, as indicated through observations in polarized light, this material was seen to be fundamentally crystalline and, in many cell membranes, in the form of diminutive fibrils varying in length and arrangement. In intimate association with the cellulose they found other substances of carbohydrate nature which definitely fell into the colloidal group in Graham's classification of chemical substances. To this group of carbohydrates as a whole they gave the name 'pectic substance'. Mangin concluded that pectic substance exists in cell walls along with cellulose from the earliest stages of formation of the membrane. He also suggested that various phenomena associated with cell wall modification, such as gelatinization and liquefaction, are due to the transformation of pectic materials.

MODERN CONCEPTIONS OF MEMBRANE COMPOSITION

This earlier work, indicating a heterogeneous composition of the plant cell wall, including the cotton fibre, has been generally disregarded during more recent years by leading workers in the field of cellulose chemistry. Instead, attempts have been made to explain reactions of the cotton fibre by analogy with the behaviour of pure substances the molecules of which are in the form of long chains. The conclusion has been drawn that variations in viscosity produced by the fibre mass can be accounted for upon the basis of variations in the degree of polymerization of the cellulose molecules. The behaviour of dispersions of derivatives of cellulosic materials has been interpreted in a similar manner. The direct application of this concept, even to the behaviour of purified cotton fibres, assumes chemical homogeneity in the fibre mass.

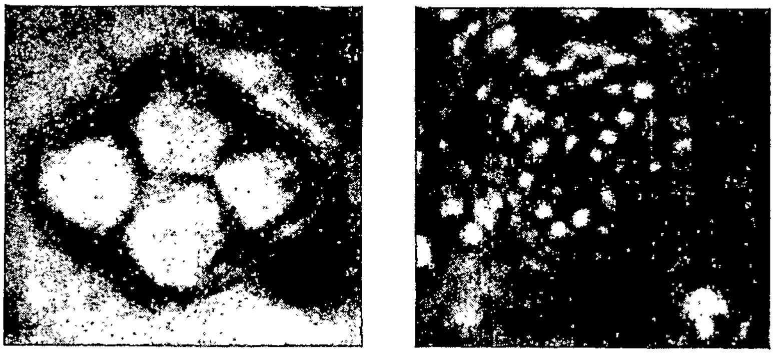
Along with this growing tendency to interpret the behaviour of the cotton fibre membrane in terms of a single organic chemical, data concerning individual fibre reactions which are incompatible with this conception have continued to accumulate. A membrane which can be shown to contain as much as 90 per cent cellulose in the form of spirally arranged fibrils, exhibits colloidal behaviour of various types not in keeping with the known chemical stability of this substance. Many of these reactions, if carefully controlled, are reversible, leaving the fibre apparently unchanged. While the techniques of microscopy and X-ray diffraction have established the fundamental crystalline nature of cellulose, the single fibre and the fibre mass in many types of reagents behave as a colloidal system. These various types of information have served to increase the uncertainty concerning the physical structure of cell membranes and the chemical nature of the membrane constituents.

CURRENT OBSERVATIONS OF MEMBRANE COMPOSITION

In 1934, after a five-year period of study by means of microscopy, X-ray diffraction, and chemical analyses, the universal presence in cell membranes from all parts of the plant kingdom of a uniform-sized cellulose crystallite was established[3]. This paved the way for a clearer understanding of the variable reactions which had been observed in cell walls. These crystallites are remarkably stable physically, and although diminutive in size ($1{\cdot}5\mu \times 1{\cdot}1\mu$), lend themselves to separation from the other membrane constituents and to both optical and microchemical analyses. They are definitely doubly refractive in polarized light; the refractive indexes of dry particles from the cytoplasm of a living cotton fibre are 1·565 lengthwise and 1·530 crosswise; they react in a manner characteristic of cellulose in the presence of sulphuric acid and iodine; and their elementary analysis is:

	Theoretical value	Found
Carbon, per cent	44·4	44·34; 44·30
Hydrogen, per cent	6·17	6·31; 6·29 (no ash)

Their X-ray diffraction pattern is that of native cellulose, and when treated with 18 per cent sodium hydroxide they give the pattern of mercerized cellulose. In other words, these ellipsoidal particles show the characteristic properties of cellulose and were designated by us 'cellulose particles'.


(A) (B)

(A) STARCH GRAINS IN THE PROCESS OF FORMATION IN A PLASTID FROM THE LIVING PROTOPLASM OF A COTTON LEAF CELL. (× 2500).

(B) CELLULOSE PARTICLES IN THE PROCESS OF FORMATION IN A PLASTID FROM THE LIVING PROTOPLASM OF A COTTON FIBRE. IN THE GROWING PLASTID RINGS OF EQUAL THICKNESS AND VARYING DIAMETER ARE FORMED SUCCESSIVELY AT THE INTERFACE OF THE PLASTID PLASMA AND THE PLASTID MEMBRANE. THESE RINGS FRAGMENT DIRECTLY TO FORM THE UNIFORM-SIZED CELLULOSE PARTICLES SHOWN IN THE INTERIOR OF THE PLASTID. (× 1500).

During the period of wall formation, the cellulose particles appear in the outer regions of the cytoplasm arranged end-to-end in orderly single rows. The fibrils thus formed can be removed from the living cells for more careful study. It then becomes clear that each particle in the fibril is coated with a viscous substance which functions as a cementing material, holding the particles together to form the fibril, and the fibrils, layer upon layer, to form the membrane lamellæ. The heterogeneous composition of the membrane is therefore clearly visible in the form of a system having a continuous colloidal phase and a discontinuous crystalline phase. The crystalline phase is made up of the cellulose particles in various forms of orientation in the different types of membranes. The colloidal phase is chemically complex in any membrane and varies widely in chemical make-up as well as relative proportion to the crystalline phase in different types of membranes.

Membranes of moist cotton fibres from the unopened boll can be disintegrated into fibrils and particles by mechanical treatment alone. The membranes of mature, dried fibres require controlled treatment with chemical reagents to bring about a similar degree of membrane disintegration[4]. As the reaction proceeds, the material surrounding the particles is observed microscopically to swell and, in so doing, to push the particles farther apart. Long-continued treatment brings about the removal of the cementing material. The significant fact is that complete membrane disintegration is thus brought about without indication of change in the physical state of the cellulose particle. The characteristics of the colloidal substances which are removed in the process of this disintegration are, in general, those described by botanists of the last century as pectic substances. It is not implied that all of these constituents of the membrane will meet the requirements of the modern chemical concept of pectic material. In our own laboratories, in addition to pectic acid[5] we have two separable constituents of the inter-particle phase not yet fully identified. There are probably more fractions than these, even in a cementing substance so comparatively simple as that of the cotton fibre. In lignified and suberized membranes many new constituents in this phase of the membrane make the problem increasingly complex.

Microscopic analyses show that the cellulose particles in the membrane of the cotton fibre are not completely freed from all traces of the cementing material until after complete fibre and fibril disintegration has taken place. These observations indicate the possibility that an intimate physical, rather than a chemical, union between the diminutive crystallites and the thin surface coating of colloidal material may more nearly explain the observed properties of the membrane. In the final analysis both types of bondage may be found to be in operation. In any event, a satisfactory interpretation of the behaviour of the cotton fibre must take into consideration all the components which go to make up its intricate fibrillar and lamellate structure. Standard purification treatments frequently show little measurable effect upon the more general physical properties of the fibre.

Techniques are not yet available that will indicate finally which, if any, of the fractions of the cementing material can be removed without producing complete disintegration of the membrane.

The heterogeneous chemical nature of these plant cell membranes is not clearly in evidence in many of the experimental procedures now in common laboratory usage. Under the specific conditions employed, the conception of chemical homogeneity is frequently adequate for the final interpretation of data. The discovery of the cellulose particle, the observation of its intimate association with the cementing material, and the reactions of this two-phase system in different types of reagents do not conflict with the results obtained by other workers who have studied the reactions of plant cell membranes, assuming them to be pure cellulose[6]. Rather they represent a more detailed consideration of many of the experimental techniques now commonly used. The uniform shape and diminutive size of the cellulose particles, along with their even distribution in the colloidal material, tend to produce those reactions of the membrane long observed by workers who considered it a single-phase rather than the two-phase system which we have found it to be.

In the course of these first observations of the formation and structure of plant cell membranes, by cellulose particles and cementing material elaborated in the protoplasm of living plant cells, no clue was obtained as to the mechanism of formation of the cellulose particles themselves. During the past few months living cells of tropical marine algæ have proved to be excellent material for the solution of this problem. As the plastid enlarges, upon the inner surface of the chloroplast membrane are formed successively rings of varying diameter but equal thickness. These rings fragment directly to produce the uniform-sized cellulose particles.

In the cotton fibre and many other types of higher plant cells, colourless plastids produce cellulose particles by essentially the same mechanism. In chlorophyll-containing cells of the higher plants, the sugar and starch are manufactured in the chloroplasts and the cellulose in separate colourless plastids within the same cell. Starch formation in plastids of living cells was described before 1850. Cellulose formation has been more elusive and the mechanism which we now find in operation in many types of cells has been hitherto undescribed.

[1] Payen, A., "Mémoire sur les développements des végétaux". (Paris 1842.)

[2] Mangin, L., "Étude Historique et Critique sur la Présence des Composés Pectiques dans les Tissues des Végétaux", *J. Bot.*, **5**, 400, 440 (1891); **6**, 13 (1892).

[3] Farr, Wanda K., and Eckerson, Sophia H., "Formation of Cellulose Membranes by Microscopic Particles of Uniform Size in Linear Arrangement," *Contrib. Boyce Thompson Inst.*, **6**, 189–203 (1934).

[4] Farr, Wanda K., "Certain Colloidal Reactions of Cellulose Membranes", *J. Phys. Chem.*, **41**, 987–995 (1937).

[5] Harris, Stanton A., and Thompson, H. Jeanne, "Pectic Acid from the Cotton Fiber", *Contrib. Boyce Thompson Inst.*, **9**, 1–5 (1937).

[6] Farr, Wanda K., "The Microscopic Structure of Plant Cell Membranes in Relation to the Micellar Hypothesis", *J. Phys. Chem.*, **42**, 1113–1146 (1938).

COLOUR VISION AND CHROMATICITY SCALES

By Dr. W. D. Wright,

Imperial College of Science and Technology, London

Colour Vision

It is no easy matter to assess the value of recent additions to our knowledge about colour and colour vision. So much fundamental information had been recorded twenty-five or fifty years ago by König, Abney, Helmholtz, v. Kries, Hering and other pioneers, that modern work appears at first sight to consist largely of filling in gaps here and there, and of improving the accuracy of the data by taking advantage of improved apparatus and photometric technique. This is especially true in regard to colour mixture and colour discrimination data, while on such questions as colour contrast, after-images, colour fatigue and the like, an enormous amount of quantitative work still remains to be done.

One most important feature of modern research, however, is that there exists a marked disinclination to make extensive theoretical deductions that have no adequate experimental backing. Earlier, highly ingenious and involved theories of colour vision were developed on the flimsiest of foundations, and burning controversies would be waged as to their relative merits; all this, in spite of the fact that very little was known about even the first reaction that takes place when light enters the cones, the colour perception mechanism in the retina. Perhaps only subconsciously, but none the less definitely, it has at last become recognized that the assault on the mysteries of the retina and brain is not going to be carried by a *Blitzkrieg*, either theoretical or experimental; there can be no short-circuiting of an immense amount of patient and laborious investigation.

Nevertheless, there has been progress. On the purely physiological side, a great deal of very valuable information has been accumulated about visual purple and its derivatives. This is, in a sense, only a preliminary to an examination of the colour perception mechanism, since visual purple is essentially associated with the rods, and the marked difference between rod vision and cone vision suggests that any photochemical substance occurring in the cones is likely to be very different from that in the rods. Further, with the aid of modern amplifier equipment, physiologists can now record the electrical impulses sent out along a nerve fibre from a single receptor in the retina of an excised eye, following stimulation by light. Investigations have already been started to measure the variation in the response with wave-length, and in the near future we may hope to learn whether or no three types of receptor sensitive to different parts of the spectrum do exist. This may perhaps be the most important single step forward since visual purple was isolated.

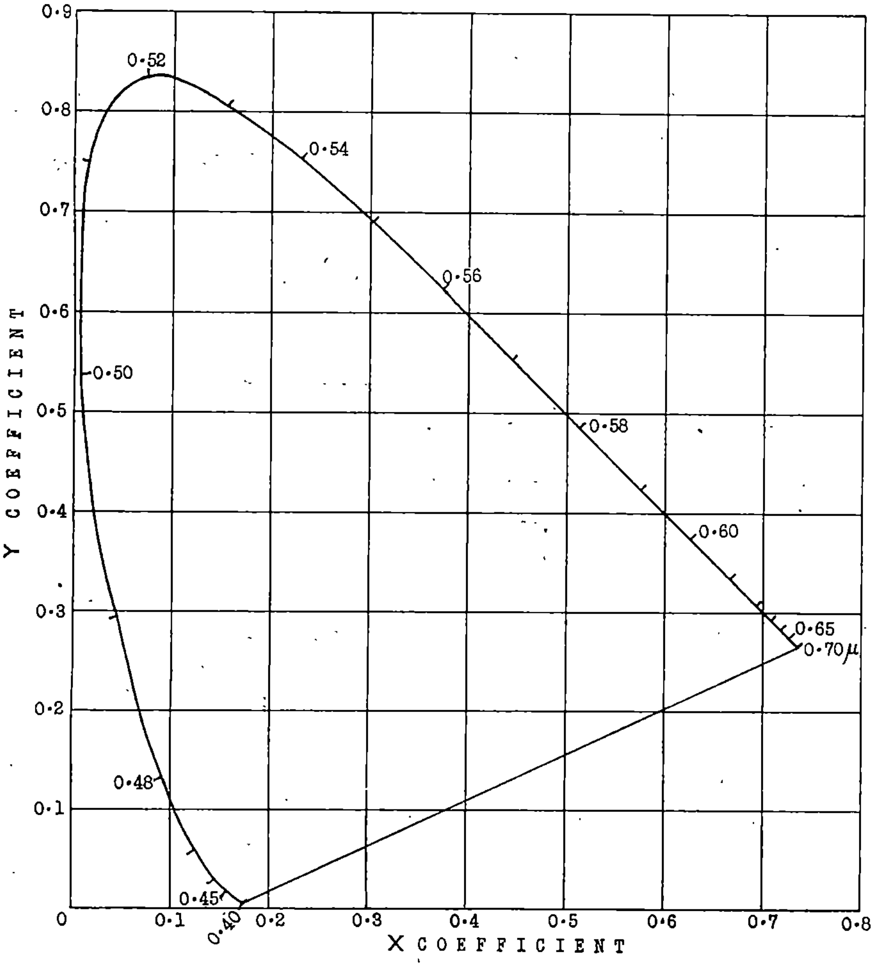


Fig. 1.

THE C.I.E. COLOUR CHART PLOTTED WITH RECTANGULAR CO-ORDINATES, SHOWING THE LOCUS OF THE COLOURS IN THE SPECTRUM.

Subjective investigations have also, during the past few years, broken fresh ground. The data about the different types of colour-defective observer are now very much more complete, especially as regards luminosity, colour mixture and colour discrimination. Again, very remarkable effects have been observed by varying the angle of incidence at which a narrow pencil of light strikes the retina, and they have led to suggestive ideas regarding the operation of the light-sensitive layer in the retina. A third type of investigation is that in which adaptation changes have been recorded quantitatively by a method of binocular matching, in which one eye is kept in a constant state of adaptation and used as a reference against which changes induced in the other eye can be recorded. By this means, photochemical and electrical reactions that would be most difficult to record by any direct physiological method can be followed with comparative ease.

In spite of this steadily increasing volume of information, it is doubtful whether workers on colour vision would be prepared at the moment to say more than that there is a photochemical reaction in the cone, and that at some stage, almost certainly in the retina, the response divides into three components. How this division occurs, how the three types of response that we may for convenience label red, green and blue, are transmitted separately to the brain, and how they are identified when they arrive, are questions that cannot yet be answered.

COLOUR MEASUREMENT

Because colours can be matched by an additive mixture of three radiations (generally, but not necessarily, a red, green and blue are chosen), it is possible to specify a colour in terms of the amounts of the three radiations required to match it. For measurements to have a recognized meaning, a number of factors have to be standardized. Modern colorimetry dates from 1931, when the Commission Internationale de l'Éclairage (C.I.E.) standardized the colour mixture data of a 'normal' eye and introduced a standard framework in which any colour could be specified.

In the C.I.E. system a colour is expressed in terms of the three co-ordinates X, Y and Z by an equation of the type

$$C = x.X + y.Y + z.Z.$$

X may here be regarded as the red co-ordinate, Y as the green and Z as the blue. Since the colour is governed only by the relative proportions of the three components, no loss of generality in the colour specification is introduced if the coefficients

$$x + y + z = 1.$$

In this case the amount of colour represented by such a unit equation is known as '1 trichromatic unit' and since, with this restriction, there are now only two independent variables, any colour can be represented by its position on a two dimensional diagram. Thus the locus of the spectrum colours in terms of the C.I.E. co-ordinates is given by the curve in Fig. 1, and this diagram may be regarded as the C.I.E. colour chart, the distribution of colours in the chart being governed by the particular choice of the reference colours X, Y and Z and their units.

The stage was thus set for the development of a practical system of colorimetry, but although this standardization was a necessary preliminary to the actual business of making standard colour measurements, much remained to be done.

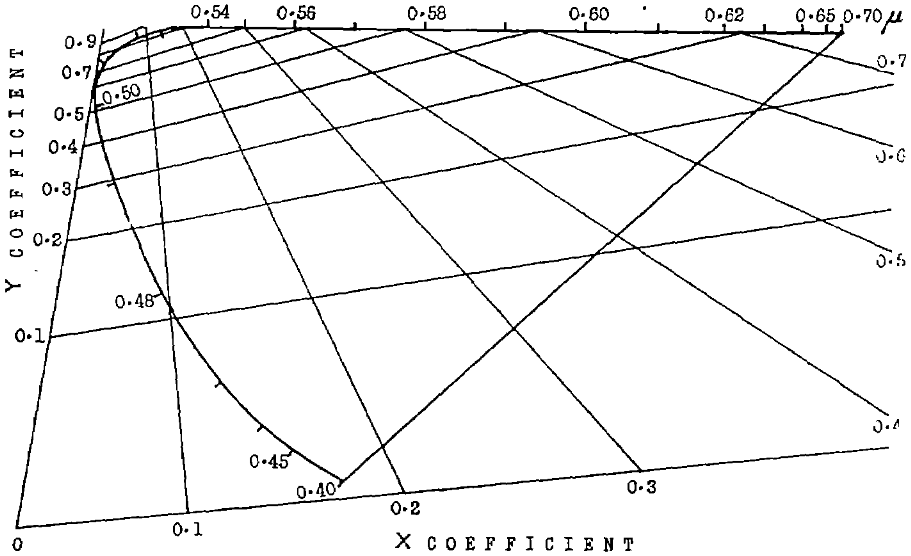


Fig. 2.

THE SPECTRUM LOCUS PLOTTED ON AN OBLIQUE PROJECTION OF THE C.I.E. COLOUR CHART TO GIVE A MORE UNIFORM COLOUR DISTRIBUTION.

The measurements can be made either visually or by means of a photo-electric device. In either case the accuracy of the measurement may have to be very high, because when two samples of considerable area are compared side by side the eye is extremely sensitive to quite small colour differences. In a visual colorimeter, the matching field has to be small owing to the structure of the eye, so that matches may not be possible to the accuracy demanded by the customer. Again, unless the matches are recorded by an eye that has the same characteristics as the standard eye, there will in general be a residual error from this cause. Difficulties of this kind can to a considerable extent be overcome by the extensive adoption of substitution methods. There is nothing illegitimate in doing this—substitution methods are continually in use in photometry—but it undoubtedly adds to the complexities of colorimetry.

It is not difficult to design a photo-electric colorimeter that has, in most cases, sufficient sensitivity, but it is very difficult indeed to produce an instrument that will give the right answer. For this purpose, three photo-cells are required that have spectral sensitivities corresponding to the X, Y, Z distribution curves through the spectrum, or linear transformations of these curves. This result might be obtained by one cell and three colour filters, or three cells and three filters, the filters being either normal gelatine or glass filters, or more probably spectrometer systems with a suitable template in the plane of the spectrum. A very considerable amount of development work still remains to be done before a satisfactory instrument on these lines is available for industrial purposes.

A more indirect approach is to measure the energy distribution through the spectrum of the light from the sample. When this is known, the calculation of the colour co-ordinates from the standard C.I.E. data is perfectly straightforward. This method, which only involves matches between two halves of a field of identical physical composition, has the outstanding merit that the spectral sensitivity of the eye or cell that is used has no effect on the result. It is, however, either very laborious or, if a recording spectro-photometer is used, very costly in equipment and operating personnel. It is a question for the industrialist to decide whether the cost is justified. The decision should, however, be made in the light of the fact that the spectrophotometric curve has other uses than just the calculation of the colour co-ordinates of any particular sample ; in the case of dyes, for example, it provides the essential data from which the colour of a mixture of dyes can be derived, and thus enters into the very heart of the dyeing industry. It is not to be expected that an elaborate device such as the photo-electric spectrophotometer will at first be able to compete economically with the experience of the craftsman acquired through many decades in industry, but there is no doubt whatever that here is a tool which should in time prove to be of the greatest possible value.

CHROMATICITY SCALES

It is of interest to consider whether, after a testing period of nine years, the system of colorimetry recommended in 1931 is free from criticism. Inevitably a few minor points have arisen that have called for further discussion, but it may be said that as a means of colour specification the system has proved entirely satisfactory and is being very widely adopted. It is from a somewhat different point of view that the system has proved less satisfactory. It has already been suggested that the diagram in Fig. 1 is not only a graphical means of expressing a numerical result, but also has to perform the additional functions of a colour chart. A good colour chart is characterized by a uniform grading of colours from one part of the chart to another, but in this the C.I.E. diagram fails, and fails in no small degree. What is required is a 'uniform chromaticity diagram', to use a term popular in the United States, in which a given distance always corresponds to an equivalent colour difference, in whatever part of the diagram and in whatever direction the distance is measured.

A uniform distribution of colours is not desirable for any pictorial virtues that it might possess, but for very material considerations of convenience when expressing colour tolerances and when estimating the importance of errors in matching, say, a number of dyed samples. An arbitrary re-distribution of the colours in the C.I.E. diagram is not possible because, on the trichromatic system, there is a definite algebraic relation between different points in the colour field. By certain linear transformations a new oblique projection of the present diagram could be used, and by this means a closer approximation to a uniform distribution can be obtained. At the moment further experimental data on colour discrimination are required before a final decision can be reached as to the projection that will give the most uniform distribution.

The disadvantages of using a fresh diagram are that either a new system of co-ordinates must be adopted, or else a specially prepared colour diagram must be used in which the X, Y and Z co-ordinates are no longer rectangular. Fig. 2 shows a diagram of this type due to Holmes[1], in which the colour field has been distorted to the shape required to give the uniform chromaticity scale proposed by Breckenridge and Schaub[2]. A change in the co-ordinate system itself is certainly to be deplored unless unavoidable ; not only would it cause a great deal of inconvenience, but also it would tend to discredit colorimetry in the eyes of the industrialist. If a diagram such as Fig. 2 is ultimately adopted, it will always have to be borne in mind that the uniformity of colour distribution is at best only approximate. Further observations will show whether the approximation is sufficiently good to be worth having.

---

[1] Holmes, J. G., *Proc. Phys. Soc.*, 52, 359 (1940).

[2] Breckenridge, F. C., and Schaub, W. R., *J. Opt. Soc. Amer.*, 29, 370 (1939).

OBITUARIES

Mr. H. Guthrie-Smith

THE death of Mr. H. Guthrie-Smith, fellow of the Royal Society of New Zealand, recorded in *The Times* on July 8, is a very sad loss. Not only was he one of the most observant and learned of Dominion naturalists, but also a man of great kindness and charm.

Tutira, his homestead, between Napier and Wairoa in the Hawke's Bay Province of New Zealand, has become a classic from his fascinating book, "Tutira—The Story of a New Zealand Sheep Station" (1920 ; second edition, 1926), which gives a full history of all the changes that have taken place day by day on the station during the past fifty or more years. In this account he gives a comprehensive picture of the physical features, soils, erosion and surface slips, the former forest covering and the vegetation which covered the area of the station before settlement. Then come interesting chapters dealing with the changes which have gradually or rapidly taken place due to chance or deliberate plant introductions and the stocking of the station with sheep, and later with cattle and goats, in order to check the insidious blackberry, which has brought such havoc on Tutira ; getting a hold during the War of 1914–18 when labour was scarce, it has spread like a devouring plague. In a letter to me a few years ago, after referring to the devastation of the rare native vegetation of the Kermadec Islands by goats which had recently been liberated there, he wrote:

"Reverting to goats where the blackberry is worst the cocksfoot grass holds best, its crown just sufficiently protected from the nibbling sheep—we have therefore the curious paradox of the more blackberry the better sward!"

Guthrie-Smith refers to the great increase of sparrows, starlings, blackbirds and thrushes, which all help to spread the blackberry, but points out that the goat, which certainly helps to keep it down, unfortunately eats everything else that comes in its way.

Guthrie-Smith had an intimate knowledge of the native New Zealand flora and of the introduced and naturalized plants, and his knowledge of the fauna was equally extensive, as readers of "Tutira" will well remember. His last book, "Sorrows and Joys of a New Zealand Naturalist" (1937), records his wanderings over many parts of the mainland and to the uninhabited islands, both to the north and south, to watch and study the birds. This, like "Tutira", is written in a very pleasant literary style, illuminated by the humour and imagination which made him so delightful a companion.

His earlier book on New Zealand birds, "Bird Life on Island and Shore" (1926), equally pleasantly written, contains vivid descriptions of species new to European readers. Other books were "Crispus a Drama" and "Mutton Birds and Other Birds".

Guthrie-Smith was born at Helensburgh in 1861, and was the son of Mr. John Guthrie-Smith of Mugdock Castle, Stirlingshire. Very soon after he left Rugby School, he went to New Zealand, where he acquired Tutira, some 20,000 acres, and made it his home. His carefully recorded observations of the changes which have taken place due to human interference, are of the greatest value, and he will be remembered with gratitude by scientific workers and naturalists both now and in years to come.

ARTHUR W. HILL.

Dr. Phyllis M. Tookey Kerridge

By the death, after a short illness, of Dr. Phyllis Margaret Tookey Kerridge, on June 22, the subject of physiology loses one of its ablest women workers, and several circles mourn a valued friend and colleague. The only daughter of Mr. William Alfred Tookey, of Bromley, Kent, she was educated at the City of London School for Girls, and at University College, London. Most of her post-graduate years were spent at the latter institution, first in the Department of Chemistry, in which subject she had taken an honours degree in 1922, and afterwards in the Department of Physiology, in which she was a lecturer at the time of her death. She also worked for various periods of time at the London School of Hygiene and Tropical Medicine, the Marine Biological Association Laboratory at Plymouth, the Carlsberg Laboratories at Copenhagen, and the Medical Unit of the London Hospital. While acting as a lecturer in the Department of Physiology at University College she studied medicine at University College Hospital, qualifying in 1933, and obtained the M.R.C.P. in 1937.

Dr. Kerridge contributed to the advance of science in several directions, covering a wide field. Her earliest work was in physical chemistry, from which she passed to the applications of that subject to problems of biology, her most distinguished work in that direction being the introduction and perfection of the glass electrode for the measurement of hydrogen ion concentrations of body fluids and tissues. This work won her an international reputation. After qualification in medicine she turned to the applications of physics, chemistry and physiology to practical requirements of medicine, and here again she distinguished herself, first in connexion with the perfection and investigation of the mode of action of the Bragg-Paul pulsator for the performance of artificial respiration, and secondly, in the many problems connected with the use of hearing aids for the deaf, and the study of the incidence of deafness in children. In this work her human sympathies found expression and her love of music gave it interest and value. For none of this clinical work, so greatly appreciated by the large number of deaf people whom she served so gladly, would she ever take a fee of any kind. The work was afterwards extended to embrace the study of speech in deaf-mutes, and had already achieved notable results. She also carried out, in collaboration with various colleagues, a number of researches of more academic interest—on buffering in tissues, on the conditions for albuminuria, and in several other directions.

All her investigations illustrated her wide acquaintance with methods, and a sure grasp of the experimental approach to a problem. As a teacher also, Dr. Kerridge will long be remembered by the many students who profited by contact with her fine and stimulating personality. Often she would encourage them to participate in her investigations, and to go round with her during their vacations on visits to Special Areas and slums in search for factors in the etiology of deafness in school-children.

Immediately on the outbreak of war, Dr. Kerridge joined the staff of an Emergency Service Hospital, where she and her colleagues fitted up an improvised laboratory for use in pathological and blood transfusion work. While this was in progress, and in the subsequent weeks and months, her cheerful personality and zeal did much to encourage all with whom she came into contact.

Dr. Kerridge was a keen musician, and a lover of the country and all that it brings to make life worthwhile, a capable botanist and ornithologist, and always a most cheerful, loyal and helpful colleague. The passing of so gallant a spirit will leave a gap in many places, and if the world of science is the poorer for her loss, it is the richer for the achievements she leaves behind after a relatively short, but very full, life. She was thirty-eight years of age.

C. LOVATT EVANS.

NEWS AND VIEWS

War Seventy Years Ago

Just seventy years ago the Franco-German War broke out. It is interesting in this connexion to quote extracts from a leading article entitled "War" published in Nature at the time:

"The dogs of war are again let loose, and in the two most highly civilised countries of Europe, where, a week ago, science, education, and commerce were in full sway, all the arts of peace are already neglected, and in prospect have gone back a quarter of a century. This journal, of course, has nothing to do with Politics: the function of Science is to unite the whole human family, whereas the function of Politics seems to be, both in the case of the human family and of each nation, to create parties and to emphasise them as much as possible, the object in each case being place for the partisans—whether that place be an income of a few thousands a year in one case or increased territory in the other. But although we cannot discuss politics, we may point out that as Science advances such policies will be overridden—that when Science and Education have taken their proper position—when the sword has given place to brain—when more of the best men of each nation take part in each nation's counsels, the dreadful thirst after blood will give way to something better; monarchs will see the folly of being surrounded merely with empty helmets and uniforms, or at all events if they do not, others will; and much will have been done when the pampering of armed men shall cease."

"If England is to prepare for war, the abnormal condition, so let it be; but surely, *a fortiori* she should *prepare for peace*, the normal one, as well. This has never struck her ministers, and the reason is not far to seek. But this is not all; the same disregard for science, arising from the ignorance of science among our rulers, has probably placed us in another position of disadvantage. While France and Prussia have been organising elaborate systems of scientific training for their armies, a recent Commission has destroyed what little chance there was of our officers being scientifically educated at all. As there is little doubt that a scientific training for the young officer means large capabilities for combination and administration when that officer comes to command, we must not be surprised if the organisation of our army, if it is to do its work with the minimum of science, will, at some future time, again break down as effectually as it did in the Crimea, or that our troops will find themselves over-matched should the time ever come when they will be matched with a foe who knows how to profit to the utmost from scientific aids."

"While, therefore, the Continent is being deluged with blood, let us *prepare for peace* as well as for war; let us prepare ourselves for victories in the arts, conquests over nature; let us, by means of a greater educational effort, more Science Schools, a truer idea of the mode in which a nation can really progress, fit ourselves to take our place among the nations when peace returns."

A Tax on Learning

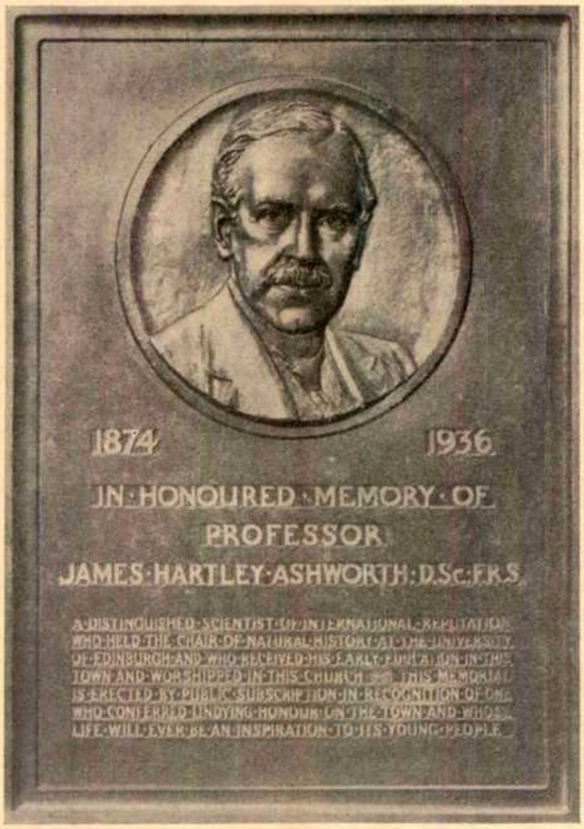
While speaking in the debate on July 24 in the House of Commons on the Budget resolutions, Mr. A. P. Herbert took up the question of the proposed sales tax in its application to books, which have been placed in the category subject to 12½ per cent tax. It will be remembered that the subject was discussed at length in Nature of May 11, p. 719. As one of the representatives of the University of Oxford, and himself an author of distinction, it was wholly appropriate that Mr. Herbert should identify himself with the movement for treating books as a commodity apart and entitled to special consideration. As he pithily remarked, he was "not speaking so much of pennies as of principle. The taxes on knowledge were finally wiped out between 1850 and 1870, and the principle was established that we would not put a tax on things of the mind." For the sake of the £500,000 which it is estimated that the tax on book sales will produce, we are being committed "to do this barbarous thing".

Lord Wolmer replied to Mr. Herbert on behalf of the Government; he said that the whole purpose of the sales taxes was to curtail consumption, and that no case had been made for regarding books differently from other commodities. No one will wish to quarrel with the general views expressed by Lord Wolmer, but we still insist that books should be exempted from this impost. The general shortage of paper and other material must lead to a reduction in quantity of publications in any event, and, as Mr. Herbert pointed out, if one new thought is held back from publication by the tax, then, on the long view, the tax is bad. To this we may add that mathematical and scientific works are notoriously expensive to produce, and that their publication frequently depends on the indirect subsidy afforded by more popular books. There is also another aspect of book sales, a short-term view, which might receive more emphasis; that is, the position of export sales. It is not sufficiently realized how large a proportion of the books produced in Great Britain are sold overseas. The export trade must be maintained, and to this end a healthy home trade is essential, for in no industry more than in book production does final cost depend on the total number of items produced at one working; prospective sales of an edition of 5,000 as against a possibility of disposing of 4,000 copies of a book may enable a publisher to make a substantial reduction in its selling price.

Camouflage in Modern Warfare

Since the publication in Nature of June 22 of the leading article under this title, correspondence has revealed the interest which has been aroused. On p. 168 a letter on the subject, written from the point of view of the artist, demonstrates that scientific workers are not alone in their criticism of the official methods of dealing with camouflage. In this connexion, it is worth while directing attention to an article in the July issue of the *Nautical Magazine*, in which Sir John Graham Kerr discusses camouflage in its application to ships at sea. The article includes a reprint of the original letter drafted by Prof. Graham Kerr, as he then was, and circulated by the Admiralty to the Navy on November 10, 1914, on the use of paint camouflage for diminishing the visibility of ships at a distance. Effective camouflage, whether on land or sea, depends on two fundamental principles: compensative or counter-shading, and parti-colouring or disruptive pattern. The effect of imitative colouring, the basis of the artist's technique, is entirely overborne by the effects of light and shadow.

Sir John points out that complete invisibility by the use of paint camouflage is out of the question. In bright light and a clear atmosphere, it is impossible to hide a large object such as a ship at sea, but in conditions of poor visibility, properly devised camouflage can make it extremely difficult to 'pick up' a ship and can disguise effectively its character, size and course. The trial or adoption of Sir John's suggestions were left to individual flag officers, and this may have accounted for the very indifferent results obtained. In 1917 a modification of these proposals was adopted, under the guidance of Mr. Norman Wilkinson (now president of the Royal Institute of Painters in Water Colours), to which the American biological term 'dazzle' was given, and was widely used for the mercantile marine, American destroyers and certain British war-vessels. As we have already pointed out, present-day methods of paint camouflage are largely ineffective, due in part to lack of co-ordination of the various departments concerned and to lack of scientific direction.


1874
1936
IN·HONOURED·MEMORY·OF
PROFESSOR
JAMES·HARTLEY·ASHWORTH:D.Sc:F.R.S.
A·DISTINGUISHED·SCIENTIST·OF·INTERNATIONAL·REPUTATION
WHO·HELD·THE·CHAIR·OF·NATURAL·HISTORY·AT·THE·UNIVERSITY
OF·EDINBURGH·AND·WHO·RECEIVED·HIS·EARLY·EDUCATION·IN·THIS
TOWN·AND·WORSHIPPED·IN·THIS·CHURCH· THIS·MEMORIAL
IS·ERECTED·BY·PUBLIC·SUBSCRIPTION·IN·RECOGNITION·OF·ONE
WHO·CONFERRED·UNDYING·HONOUR·ON·THE·TOWN·AND·WHOSE
LIFE·WILL·EVER·BE·AN·INSPIRATION·TO·ITS·YOUNG·PEOPLE

Memorial to Prof. J. H. Ashworth

THE bronze memorial plaque to the late Prof. J. H. Ashworth, a reproduction of which appears on this page, set in Yorkshire monumental stone, was unveiled at Salem Congregational Church, Burnley, by Mrs. Ashworth on June 25. Prof. Ashworth was a Burnley man, and although he spent the last twenty-five years of his life at Edinburgh, he never allowed the link with his birth-place to be broken. As professor of natural history in the University of Edinburgh, he achieved an international reputation, and by his death at the early age of sixty-one on February 4, 1936, the world lost a distinguished zoologist; NATURE lost a valued contributor whose services had extended over many years.

After the unveiling ceremony, at which the Mayor of Burnley presided, addresses were given by, among others, Prof. H. Graham Cannon, professor of zoology in the University of Manchester, and the Rev. T Ormerod, chairman of the Memorial Committee; Dr. W. Howarth, director of education at Burnley and honorary secretary of the Memorial Committee, read tributes received from Sir Thomas Holland, principal of the University of Edinburgh, Sir George Adam Smith, formerly principal of the University of Aberdeen, Sir Richard Gregory, president of the British Association and former editor of NATURE, and others. Prof. Ashworth was a great friend, a great zoologist, and a great teacher and administrator. He was the first in Great Britain to introduce a course of medical zoology, and when the time came to re-organize and build a new department of natural history in the University of Edinburgh, his powers were shown to the full. The building there which now bears his name is a lasting and worthy memorial in the community of his adoption.

Prof. W. P. Alexander

PROF. WILLIAM P. ALEXANDER has been awarded the Cornelius Amory Pugsley Medal of the Buffalo Museum of Science, for his work as a conservationist and naturalist. The medal, established by Chester D. Pugsley of Peekskill, N.Y., in honour of his father, bears the inscription: "Awarded to William Prindle Alexander for his distinguished work as a pioneer of outdoor education in state parks". Prof. Alexander, who is Hayes professor of natural history at the Buffalo Museum of Science, is widely known as a lecturer, writer, and teacher of natural history subjects. He was the originator of the Nature trail idea, his first trail having been planned in the Allegany State Park in 1921; it is now an established institution in many State and Federal parks. Prof. Alexander is a conservationist, not in the sense that he seeks to protect wild life out of season, so that the mute and helpless creatures of wood and field can be indiscriminately maimed and slaughtered 'in season', but as a protector and preserver of all wild life in every season. In addition to being the author of numerous articles on natural history, he has had published several novels.

Dr. Tweedie John Todd

DR. TWEEDIE JOHN TODD, physician and naturalist, was born at Berwick in 1789, the son of the borough treasurer. He studied medicine at Edinburgh and for several years served as a surgeon in the Navy, chiefly in the East Indies and at the Cape of Good Hope, where he made some experiments on the electric ray (Torpedo), which were afterwards published in the *Philosophical Transactions*. He retired from the Navy in 1816, and after spending some years in Italy settled in Brighton, where he soon acquired an extensive practice. He was the author of several papers on natural history which were published in the *Philosophical Transactions* and the *Journal of Science and Arts*, such as "The Regeneration of Parts in the Aquatic Salamander" and "The Luminous Power of Some of the Lampyrides". His contribution to medical literature consisted of "The Book of Analysis. A New Method of Experience", in which he endeavoured to apply Baconian induction to medicine and the other natural sciences. For many years he was engaged in a series of microscopical researches on living animals illustrative of different parts of physiological and pathological science and especially of the processes concerned in the healing and regeneration of wounded and lost parts. He left a large collection of microscope slides at the time of his death, which took place on August 4, 1840.

University Students and Compulsory Service

DR. RAYMOND PRIESTLEY, vice-chancellor of the University of Birmingham, in the course of a circular letter addressed to head masters of a number of schools in the Midlands, has pointed out that the age at which undergraduates will be called up for military service has been fixed by the Government at twenty years. This will enable many men to complete their university training before entering the Services. With the object of enhancing the value of such men to the national effort, it has been decided by the University of Birmingham that all future entrants will be required to choose one of the following options as part of their university course: (1) compulsory physical education for one year; or (2) two years service in the University contingent of the O.T.C. Those who choose the latter will be accepted for the O.T.C. only if they are approved by an interviewing board set up by the Military Education Committee, the main criteria being personality and power of leadership (latent or developed). Training in the O.T.C. will be carried out with the view of developing powers of leadership rather than training technical experts, and should prove of great interest and value to all who join, in whatever walk of life they may afterwards find themselves. The advantages of this general military training apply equally to those taking medical and dental courses, since the military background essential to an R.A.M.C. officer can be adequately acquired in this way. Those who obtain War Certificates A and B will have definite advantages when they are called up for military service; the scheme should go far towards ensuring that the best use is made of all those suitable as officers.

Fire Risk from the Smashing of Filament Lamps

EXPERIMENT shows that it is difficult to cause ignition of combustible material by means of smashing a filament lamp embedded in it. But the lampholder of a large lamp may rise to a fairly high temperature, high enough to explode certain compounds used for military purposes. It is well known that sudden breakage of a glass bulb may occur during heavy gunfire in a battleship or cruiser. It could also happen in a submarine when depth charges are exploding near it. This explains the interest now being taken in the United States Navy in fluorescent lighting for magazines and in other parts of a warship where explosives are handled. It is very difficult to set fire even to cotton-wool by smashing a lighted fluorescent lamp reposing on it.

A useful feature of the mercury fluorescent lamp is that it can easily be so graded as to emit the tone of blue light that is preferred for darkening a ship when in action at night. At present this reduced lighting effect is obtained by shading tungsten filament lamps and using a blue glass bulb, or one which has been sprayed in that colour. The *Electrical Times* of July 4 states that the U.S. Navy is having a series of experiments made with fluorescent lighting, and if it is found that this type obviates the danger due to filament lamps overheating in tropical atmospheres or when they are smashed by heavy gunfire, the mercury discharge type with fluorescent effect may find an extensive use in warships and elsewhere. It is also being recommended for mines, gasworks, petrol and benzine factories, hydrogen plant and all other places where the air is charged with explosive vapours or dust.

Daylight Observation of Venus and Jupiter

DR. A. L. PECK, of Christ's College, Cambridge, writes: "In view of the astronomical notes in NATURE of July 27, p. 128, it may be of interest to record that two planets were picked out here with the naked eye on July 28, at 9.40 a.m. B.S.T.—Venus (daylight observation of which is, of course, nothing unusual) and Jupiter. Observation of the latter was made possible by its proximity to the moon, with which it had been in conjunction a few hours before."

British Museum (Natural History): Acquisitions

THE Zoological Department has received as a donation from Admiral Sir Sidney Bailey, a series of mounted heads of North American ungulates, including a very fine moose and some exceptionally good wapiti and caribou. The collection also contains a head of a Rocky Mountain goat. Another interesting gift to the same Department is a series of ten skulls with horns of African antelopes from the Dinder River District of the Sudan, presented by Mr. T. W. H. Dore. This collection contains, among other specimens, some skulls of Soemmerring's gazelle and of the Sudan race of the roan antelope. The Department of Geology has acquired from the Committee of the Royal Literary and Scientific Institution, Bath, a collection of ninety-nine invertebrate fossils from the Mesozoic of Australia, including a number of type and figured specimens. The Trustees appreciate this recognition of the importance of housing type-specimens, other than those of local interest, in the National Collection.

Beit Memorial Fellowships for Medical Research

A MEETING of the Trustees of the Beit Memorial Fellowships for Medical Research was held on July 17. Prof. A. J. Clark, professor of materia medica in the University of Edinburgh, was appointed to the Advisory Board in succession to Prof. W. Bulloch, who resigned after twenty-nine years service. Dr. Paul Fildes was appointed honorary secretary on the resignation of Prof. T. R. Elliott from that post after ten years service. Out of the twenty-seven present fellows, nine have already been seconded from their fellowships at their own request for more direct service during the War.

The following elections were made, all with permission for each fellow to be seconded at any time for war duties: *Senior Fellowship* (£700 a year): T. A. H. Munro, to continue his studies of inheritance in mental disorders, at the Royal Eastern Counties Institution, Colchester; *Fourth Year Fellowships* (£500 a year): J. G. Chalmers, to continue his chemical studies of polycyclic hydrocarbons in experimental cancer formation, at the Research Department of the Glasgow Royal Cancer Hospital; Dr. T. R. R. Mann, to extend his work on intracellular metallo-protein compounds, especially of red blood cells, at the Molteno Institute of Biology, University of Cambridge; *Junior Fellowships* (£400 a year): M. Abercrombie, junior research fellow, Queen's College, Oxford, to study amputation neuromata and the degeneration and regeneration of mammalian nerves, at the Department of Zoology, University of Oxford; Dr. D. A. K. Black, research student of the Medical Research Council, to study metabolic and bone marrow changes in the repair of severe anæmias, at the Nuffield Department of Medicine, Oxford; Dr. G. C. Butler, 1851 Exhibition science research scholar, to study the purification and properties of gonadotrophic hormone from the pituitary gland, at the Department of Pathological Chemistry, University College Hospital Medical School, London; Dr. J. L. Madinaveitia, honorary research fellow in chemistry, University of Manchester, to study diffusing factors in bacterial filtrates and snake venoms, at the Department of Chemistry, University of Manchester; Dr. S. M. Partridge, Lister Institute student in biochemistry, to study the chemical nature of the antigen of Shiga dysentery bacteria, at the Lister Institute of Preventive Medicine, University of London; D. Whitteridge, demonstrator in physiology, Oxford, to study electrical records from brain after concussion or severe injury, at the Nuffield Department of Surgery and the Department of Physiology, University of Oxford; P. C. Williams, research grantee of the Medical Research Council, to study pituitary hormones and their excretion in clinical pathological conditions, at the Courtauld Institute of Biochemistry, Middlesex Hospital, London.

Announcements

THE Minister of Supply stated in the House of Commons on July 25 that due regard will be had to the provision of reasonable amounts of paper for educational, scientific, and technical publications.

ACCORDING to *Science* of June 28, Prof. Peter Debye, of Berlin-Dahlem, has been appointed professor and chairman of the Department of Chemistry at Cornell University. Prof. Debye has been George F. Baker visiting lecturer in chemistry at Cornell University during the past term. His son, Peter Paul Debye, will be associated with Prof. Debye in research in the Baker Laboratory of Chemistry at Cornell. Prof. Jacob Papish, who has been chairman of the Department, will continue as vice-chairman. Dr. Bruno Rossi, formerly professor of physics in the University of Padua, research associate at the University of Chicago, has been appointed associate professor of physics at Cornell.

IT is announced that the Pétain Government has dismissed M. Huismans, director-general of fine arts, M. Julien Cain, administrator of the Bibliothèque Nationale, M. Laugier, director of the national centre for scientific research, and M. Longchambon, director of scientific research, who are said to have abandoned their posts under the previous French Government without justification.

THE Council of the University of Birmingham has instituted a scheme for family allowances for members of staff whose salaries do not exceed £700 per annum. The allowance, for salaried members, is at the rate of £25 per annum for each child. The wage-earning staff receive an allowance of 2*s.* 6*d.* per week for each child less than sixteen years of age. The scheme takes effect as from February last.

IN 1920, Miss L. Jones-Bateman of Cae Glas, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick Vase to be used for the encouragement of fruit production. It is accordingly decided to offer it triennially for original research in fruit culture. Candidates should submit accounts of their work by October 31. The work dealt with should have been mainly carried out by the candidate in the United Kingdom, and mostly during the past five years.

ERRATUM. NATURE, July 20, p. 101, col. 2, paragraph on "Precautions against American Foul Brood in Bees", line 13, for "American" read "European".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase

CARBONIC anhydrase which catalyses the reversible reaction $H_2CO_3 \rightleftarrows CO_2 + H_2O$ is present in large concentrations in the red blood corpuscles and some cells of gastric mucosa of mammals. This enzyme plays an important part in accelerating the carbon dioxide output in the lungs; it appears also to promote the formation of hydrochloric acid by the parietal cells of gastric mucosa[1].

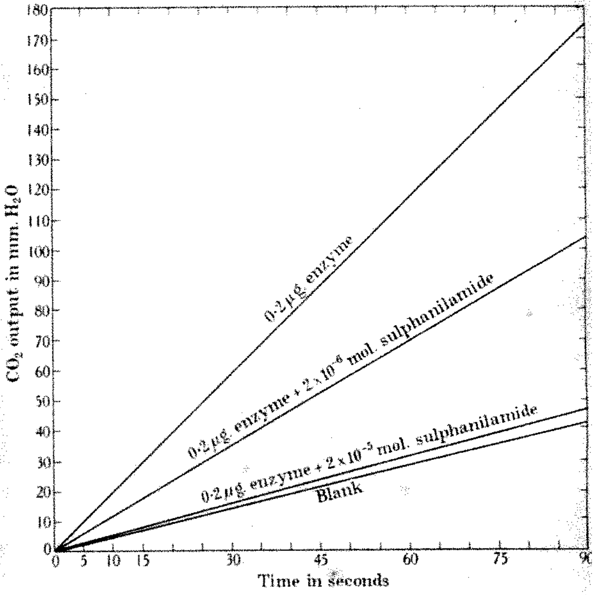
Having isolated carbonic anhydrase in a pure state, we have been able to show that this enzyme is a zinc-protein compound, where zinc forms an essential part of its prosthetic or active group[2,3]. The activity of this enzyme is very strongly and reversibly inhibited by potassium cyanide, hydrogen sulphide and sodium azide. These inhibitors, however, are not specific for carbonic anhydrase, as they are shared also by other metallo-protein enzymes such as catalase, peroxidase, cytochrome oxidase and polyphenol oxidase.

The main object of this investigation was the discovery of new and more specific inhibitors of carbonic anhydrase, as they will certainly be of great assistance in the study of several problems connected with the physiology of this enzyme. The existence of such inhibitors was revealed by the study of some drugs belonging to the class of sulphonamide compounds. The demonstration of the therapeutic efficiency of prontosil and other sulphonamide drugs in treatment of bacterial infections was followed by numerous investigations resulting in an extensive literature dealing with pharmacological and physiological properties of these compounds[4,5]. The repeated references in this literature to the fact that the administration of some sulphonamide compounds is followed by a fall in the carbon dioxide combining power of blood[6,7] suggested the possibility that some of these compounds may have an inhibitory effect on carbonic anhydrase.

This supposition was confirmed experimentally by testing the effect of sulphanilamide on the catalytic activity of carbonic anhydrase in blood, in gastric mucosa and in pure enzyme preparations. The results of these experiments summarized in the figure clearly show that sulphanilamide acts as a very powerful inhibitor of carbonic anhydrase, exhibiting marked effect even in a concentration so low as 2×10^{-6} mol.

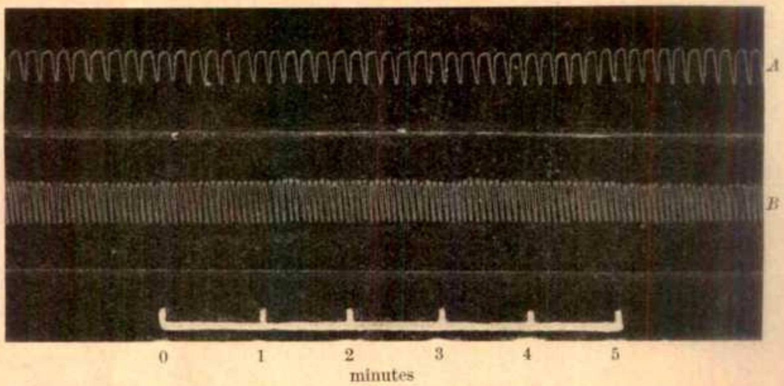
In order to determine which portion of the sulphanilamide molecule (*p*-aminobenzene-sulphonamide $[NH_2C_6H_4.SO_2NH_2]$) is responsible for the action on the enzyme, the effects of a number of other compounds belonging to the sulphonamide group have been tested and the results of these tests can be summarized as follows:

(1) The amino-group of sulphanilamide, which is essential for the therapeutic properties of this compound, is not responsible for the inhibition of the carbonic anhydrase. In fact, its loss as in benzene-sulphonamide $[C_6H_5SO_2NH_2]$, its acetylation as in acetylaminobenzene sulphonamide $[CH_3CONHC_6H_4SO_2NH_2]$ or its shift to *ortho*- or *meta*-positions do not affect in the least the properties of these compounds as inhibitors of carbonic anhydrase.



EFFECT OF SULPHANILAMIDE ON THE ACTIVITY OF CARBONIC ANHYDRASE (TESTED BY MELDRUM AND ROUGHTON METHOD AT 0° C.).

(2) The sulphonamide group appears to be directly concerned with the inhibitory effect of these drugs since the replacement of both hydrogen atoms, or even one in the amido-group, causes a complete loss of the inhibitory property; thus while substances like prontosil $[(NH_2)_2C_6H_3.N{=}N.C_6H_4.SO_2NH_2]$, benzyl-sulphanilamide $[C_6H_5.CH_2NH.C_6H_4.SO_2NH_2]$, pyridine-3-sulphonamide $[C_5NH_4.SO_2NH_2]$ and amino-naphthalene-sulphonamide $[NH_2C_{10}H_6.SO_2NH_2]$ are acting as inhibitors, substances like benzene-sulphonchloride $[C_6H_5.SO_2Cl]$, sulphanilic acid $[NH_2.C_6H_4.SO_2OH]$, sulphanil-acetamide $[NH_2.C_6H_5.SO_2NH.COCH_3]$, Diseptal A $[NH_2C_6H_4.SO_2NH.C_6H_4.SO_2N.(CH_3)_2]$, Diseptal B $[NH_2C_6H_4.SO_2NH.C_6H_4.SO_2NH.CH_3]$, Rodilone $[CH_3CO.NHC_6H_4.SO_2.C_6H_4.NH.COCH_3]$, sulphapyridine (M. & B. 693) $[NH_2C_6H_4.SO_2NH.C_5NH_4]$, pyridine-3-sulphonic acid $[C_5NH_4.SO_2OH]$ and sulphathiazol $[NH_2C_6H_4.SO_2NH.C_4NH_4]$ do not interfere with the activity of carbonic anhydrase. This enzyme therefore appears to be an exceptionally sensitive biological test capable of detecting a few micrograms of an unsubstituted sulphonamide compound.



RATE OF HEART-BEAT OF THE CRESTED NEWT, BOTH ANIMALS AT 0° C. *A*, ACCLIMATIZED TO 30° C.; *B*, ACCLIMATIZED TO 10° C.

(3) Sulphamic acid [NH_2SO_2OH] and sulphamide [$NH_2SO_2NH_2$] inhibit the activity of carbonic anhydrase to a much smaller extent, however, than benzenesulphonamide or sulphanilamide.

As to the mechanism of the inhibition of carbonic anhydrase by these compounds, it is conceivable that the sulphonamide group reacts directly with the zinc-containing prosthetic group of the enzyme. This appears to be supported by the following considerations. The inhibition by sulphonamide compounds does not require a period of incubation, on the contrary it is immediate even at low temperatures, it is also very strong and completely reversible. In this respect it shows great resemblance to inhibitions produced by reagents such as potassium cyanide, hydrogen sulphide and sodium azide which are known to react with metals. Both sulphamic acid and sulphamide are known to form compounds with metals. Moreover, benzene-sulphonamide, like some other acid amides, reacts with alkaline metal-amide compounds including zinc-amide[8,9].

The experiments which we have carried out in order to determine the effect of sulphonamide compounds on other enzymes have shown that even in concentrations as high as 10^{-2} mol. they have little or no effect on enzymes such as catalase (purified preparation from liver), peroxidase, cytochrome oxidase, polyphenol oxidase, xanthine oxidase, uricase, urease and carboxylase.

The inhibitory effect of sulphonamide compounds on carbonic anhydrase appears to be highly specific. These inhibitors therefore make it possible to abolish the activity of carbonic anhydrase in cells and organisms without affecting the activity of other known catalytic systems.

For the gift of several substances used in this investigation we wish to thank Dr. H. King, Dr. T. A. Henry, Dr. H. McIlwain, Dr. W. J. C. Dyke of the Evans Biological Institute, May and Baker, Ltd., and Schering, Ltd.

Molteno Institute,
University, Cambridge.
July 11.

T. MANN.
D. KEILIN.

[1] Davenport, H. W., *J. Physiol.*, **97**, 32 (1939).

[2] Keilin, D., and Mann, T., NATURE, **144**, 442 (1939).

[3] *ibid.*, *Biochem. J.* (in the press).

[4] Findlay, G. M., "Recent Advances in Chemotherapy" (London, 1939).

[5] Marshall, E. K., *Physiol. Rev.*, **19**, 240 (1939).

[6] Southworth, H., *Proc. Soc. Exp. Biol.*, **26**, 58 (1937).

[7] James, G. W., *Biochem. J.*, **34**, 633 (1940).

[8] Franklin, E. C., *et al.*, *Amer. Chem. J.*, **23**, 277 (1900); **28**, 83 (1902) *J. Amer. Chem. Soc.*, **37**, 2279 (1915).

[9] Audrieth, F. L., *et al.*, *Chem. Rev.*, **26**, 49 (1940).

Temperature Coefficients and Acclimatization

CERTAIN biologists (especially Crozier[1] and his school) have formulated theories on the effects of changing temperatures on protoplasm. The numerical value of the temperature coefficient $\left(= Q_{10} = \dfrac{\text{velocity at } (t+10)^\circ\text{ C.)}}{\text{velocity at } t^\circ\text{ C.}}\right.$ of a biological reaction is believed to afford a clue to the nature of the controlling physical or chemical changes. I consider that theories based on such evidence may often be misleading.

I showed recently[2,3] that the position of the chill coma temperature (that is, the highest temperature at which immobilization occurs) for insects and Amphibia is not rigidly fixed but may be altered many degrees by first acclimatizing the animal—and acclimatization is usually complete within as short a period as twenty-four hours—to a high or a low temperature. Not only is the chill coma temperature affected, but the reactions of some tissues may be modified also. In the case of the crested newt, *Triton cristatus*, animals from stock were acclimatized to 10° C. and 30° C. by exposure to these temperatures for twenty-four hours, they were then immersed in water at 0° C. or 10° C. and the rate of heart-beat determined. Results are given in the table. In the accompanying figure tracings from two newts differently acclimatized and then both cooled to 0° C. are shown.

NUMBER OF HEART-BEATS OF THE CRESTED NEWT PER MINUTE.

	Acclimatized to 10° C.	Acclimatized to 30° C.
At 0° C.	14	6
At 10° C.	25	16

If all these results are considered, and the fact that some of the animals were differently acclimatized is, for the moment, neglected, four values of the temperature coefficient may be obtained, namely, 1·1, 1·8, 2·7, 4·2. The two extreme values (1·1, 4·2) are mainly of interest because certain other workers have not ensured that all their animals came from identical conditions; the results of such experiments will be difficult to interpret. The other values of the temperature coefficient of the newt's heart over the range between 0° C. and 10° C. show that the acceleration for an animal acclimatized to 10° C. ($Q_{10} = 1 \cdot 8$) might be assumed to be controlled by a physical 'master reaction', while that in the one acclimatized to 30° C. ($Q_{10} = 2 \cdot 7$) the controlling reaction would be thought to be of a chemical nature.

Such explanations appear to me unsatisfactory. The reasons for the increase in velocity of almost any biological reaction with an increase in temperature are very imperfectly understood; these observations on acclimatization may eventually help in the formulation of a satisfactory explanation.

At every temperature some acclimatization is probably going on in a living tissue, the extent of the acclimatization depending partly on the length of the exposure. This appears to me to mean that at any particular temperature there may be no absolute rate for a biological process, and that all conditions previously experienced by the animal must be considered. Otherwise any theory based on the speed of a reaction must be treated with great caution.

KENNETH MELLANBY.

The University,
Sheffield, 10.
July 10.

---

[1] Crozier, W. J., *J. Gen. Physiol.*, **7**, 189 (1924).

[2] Mellanby, K., *Proc. Roy. Soc.*, B, **127**, 473 (1939).

[3] Mellanby, K., *J. Physiol.* (in press) (1940).

Evidence of Demethylation in the Animal Body

DURING the course of work on the metabolism of synthetic œstrogenic compounds[1] undertaken at this Institute, attention has been directed to the methyl ethers of some of the synthetic œstrogenic phenols. Preliminary experiments have been carried out on 4 : 4′-dimethoxy diphenylether and 4-methoxy diphenyl; 4 : 4′-dihydroxy diphenylether having been shown to produce full œstrous response when injected at a dose of 100 mgm. into ovariectomized rats, and 4-hydroxy diphenyl shown to have no œstrogenic activity at a dose of 100 mgm.[2]

3 gm. of 4 : 4′-dimethoxy diphenylether, dissolved in sesame oil, were injected into two female rabbits over a period of three weeks, the urine being collected during this period and for a further week after the last injection. From the 'free' and 'combined' phenolic extracts prepared from the urine a crystalline phenol was obtained by repeated extraction with boiling water, 47 mgm. occurring in the 'free' state and 22 mgm. in the 'combined' state. After several recrystallizations from petroleum ether this phenol melted at 90° C. and was shown to be 4-methoxy-4′-hydroxy diphenylether.

3 gm. of 4-methoxy diphenyl were injected into two rabbits in the same way as above, and a crystalline solid obtained from the 'free' and 'combined' phenolic extracts prepared from the urine, 203 mgm. occurring in the 'free' state and 43 mgm. in the 'combined' state. After several recrystallizations from benzene 30 mgm. of a crystalline phenol m.p. 268° C. were obtained and shown to be identical with 4 : 4′-dihydroxy diphenyl m.p. 272° C. From the benzene mother liquors 111 mgm. of another crystalline phenol m.p. 162° C. were obtained and shown to be identical with 4-hydroxy diphenyl, m.p. 163° C.

These results show that demethylation definitely occurs in the animal body and gives support to the suggestion made by Westerfeld[3] that œstrone methyl ether is metabolized in the body to œstrone.

Work on the metabolism of the methyl ethers of the highly active synthetic œstrogenic phenols is now in progress.

S. W. STROUD.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
July 3.

---

[1] Stroud, S. W., *J. Endocrin.*, **1**, No. 2, 201 (1939); **2**, No. 1, 55 (1940).

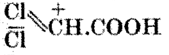
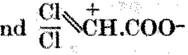
[2] Dodds, E. C., and Lawson, W., *Proc. Roy. Soc.*, B, **125**, 222 (1938).

[3] Westerfeld, W. W., *Biochem. J.*, **34**, 51 (1940).

Resonance in the Chloroacetic Acids

IN a recent letter[1], H. O. Jenkins has made the interesting suggestion that the high acid dissociation constants of di- and tri-chloroacetic acids are largely due to the possibility of a resonance structure in their anions. It is the purpose of this note to indicate a possible means of testing this hypothesis.

The strengths of acids or bases are in general a good measure of the velocity with which they will lose or gain protons. This is shown by the wide validity of relations of the form $k = GK^{\alpha}$, where k is the velocity of a catalysed reaction, K the strength of the catalysing acid or base, and G and α constants for a given solvent, temperature and reaction[2]. However, this parallelism will break down if the acid and base involved in the equilibria used for defining acid-base strengths have different electronic structures. The extreme case of this behaviour is met with in pseudo-acids, where the charge on the anion may reside on an atom other than that from which the proton has been removed (for example, $CH_3NO_2 \rightarrow CH_2 : NOO^- + H^+$). This point was realized by Brönsted when he first proposed quantitative relations of the above type, and it was in fact shown that in the decomposition of nitramide the ions of pseudo-acids had a much smaller catalytic effect than would be predicted from their dissociation constants[3].

The same type of argument applies in general to cases where resonance structures occur in only one member of an acid-base pair. In the case of dichloroacetic acid, let the 'normal' molecule and ion be denoted by H*A* and *A*⁻, and the resonance structures  $\genfrac{}{}{0pt}{}{\text{Cl}}{\overline{\text{Cl}}}\!\diagdown\!\!\diagdown\overset{+}{\text{C}}\text{H.COOH}$ and  $\genfrac{}{}{0pt}{}{\text{Cl}}{\overline{\text{Cl}}}\!\diagdown\!\!\diagdown\overset{+}{\text{C}}\text{H.COO}^-$ by H*R* and *R*⁻. Let us suppose for the sake of simplicity that the molecule exists almost entirely as H*A*, and the ion almost entirely as *R*⁻. The best measure of the tendency of H*A* to lose a proton is given by the constant $[H^+]\,[A^-] / [HA]$, which is much smaller than the observed dissociation constant $[H^+]\,[R^-] / [HA]$: hence the dichloroacetic acid molecule will be a less powerful acid catalyst than would be expected from its dissociation constant. Similarly, the tendency of *R*⁻ to pick up a proton is represented by $[HR] / [H^+]\,[R^-]$, which is smaller than the observed constant $[HA] / [H^+]\,[R^-]$: hence the dichloroacetate ion will be a less powerful basic catalyst than would be expected from the dissociation constant of the acid. In a catalytic reaction involving dichloroacetic acid or its ion, the transition state will actually be intermediate in structure between *A* and *R*, but the same qualitative conclusions will apply.

There is a certain amount of experimental evidence for the existence of this effect. Thus in the iodination of acetone[4], the catalytic effect of dichloroacetic acid is about 30 per cent lower than the value calculated from an equation based on seven other carboxylic acids (average deviation 8 per cent). Similarly, in the decomposition of nitramide[3,5,6], the catalytic effect of the dichloroacetate ion is 35 per cent lower than the calculated value (based on twelve other anions: average deviation 4 per cent). There appear to be no other cases for which sufficiently full or accurate data are available.

These results lend some support to the view that a resonance structure plays a part in the dichloroacetate ion. On the other hand, the effects observed are smaller than might be expected if resonance is a major cause of the thirty-fold increase of dissociation constant in passing from $CH_2Cl.COOH$ to $CHCl_2.COOH$.

R. P. BELL.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford.

[1] Jenkins, NATURE, **145**, 625 (1940).

[2] For a summary, see Bell, *Trans. Farad. Soc.*, **34**, 229 (1938).

[3] Brönsted and Pedersen, *Z. phys. Chem.*, **108**, 185 (1924).

[4] Results of Dawson *et al.*, *J. Chem. Soc.* (1913–29) in some cases recalculated.

[5] Pedersen, *J. phys. Chem.*, **38**, 581 (1934).

[6] Bell and Baughan, *Proc. Roy. Soc.*, A, **158**, 464 (1937).

Mechanism of the Neutron Loss Reaction Produced by Deuterons

IN a recent letter in NATURE, Krishnan and Banks[1] reported an interesting new type of nuclear transformation. Copper, consisting of two stable isotopes 63 and 65, was bombarded with deuterons, and the radioactive isotope Cu^{62} (10·5 min.) was obtained. The transformation was found to have a threshold at a deuteron energy of about 7 Mev. By analogy with the well-known reaction

$$Cu^{63}\ (n-2n)\ Cu^{62}, \qquad (1)$$

Krishnan and Banks suggested that a new kind of neutron loss reaction might explain their results, either

$$Cu^{63}\ (d-d, n)\ Cu^{62}\ (2), \quad \text{or} \quad Cu^{63}\ (d-p, 2n)\ Cu^{62}\ (3)$$

From some further observations they concluded that reaction (3) was more probable. In a similar way they interpreted previous results of Krishnan and Gant[2], who had found that Ag^{107} could be transformed by 9 Mev. deuterons into Ag^{106} (26 min.). For this case, however, the threshold energy has not yet been determined.

Recently, in the course of an investigation of the radioactivity produced when beryllium is bombarded by deuterons, a different type of neutron loss reaction was established in this laboratory[3], namely, the reaction

$$Be^{9}\ (d-H^{3})\ Be^{8}.$$

It seemed, therefore, worth while to examine the possibility that the effect reported by Krishnan and Banks might be due to the analogous reaction

$$Cu^{63}\ (d-H^{3})\ Cu^{62} \qquad (4)$$

If we denote by $E\ (D^2)$, $E\ (H^3)$ and $E\ (Cu^{63})$ the energies necessary to remove a neutron from D^2, H^3 and Cu^{63} respectively, and by $E_1, \ldots E_4$ the threshold energies of reactions (1) . . . (4), we obtain the following simple relations.

$$E_1 = E_2 = E\ (Cu^{63}),\ E_3 = E\ (Cu^{63}) + E\ (D^2),\ E_4 = E\ (Cu^{63}) - E\ (H^3).$$

The threshold energy of reaction (1) has been measured by Sagane[4], who found a value between 12 and 13 Mev. His work has been confirmed by Salant and Ramsey[5], who find a value close to 12 Mev. We shall adopt for the following the value $E_1 = 12$ Mev. The binding energy of the deuteron is known, $E\ (D^2) = 2{\cdot}2$ Mev. $E\ (H^3)$ can be easily calculated from the masses of H^3, D and n. We find, using Barkas' compilation of masses[6], $E\ (H^3) = 6{\cdot}2$ Mev.

With these values we obtain for the threshold energies of reactions (2, 3, 4)

$$E_2 = 12\ \text{Mev.},\ E_3 = 14{\cdot}2\ \text{Mev.},\ E_4 = 5{\cdot}8\ \text{Mev.}$$

It appears that the $(d-H^3)$ reaction (4) can best account for the observed threshold of about 7 Mev.

If we assume that a $(d-H^3)$ process takes place according to the 'compound nucleus' model of nuclear reactions developed by Bohr, it appears difficult to understand why the reaction is observable with a nucleus of so high an atomic number as $Z = 29$ (Cu) or even $Z = 47$ (Ag). For, with deuteron energies below 9 Mev.[1,2], the H^3 particle will be emitted with an energy considerably below the top of the potential barrier, and consequently, once the highly excited compound nucleus is formed, the probability of emission of an H^3 article will be quite negligible compared with the probability of emission of a neutron or proton. It would seem preferable, therefore, to picture the $(d-H^3)$ reaction without postulating the formation of a compound nucleus. We would then have to assume that a deuteron with an energy exceeding the threshold could capture a neutron in a collision with the nucleus without entering it. Near the threshold, the Coulomb force between the final nucleus and the H^3 particle would lead to a very small probability of the $(d-H^3)$ reaction. This might account for the fact that the lowest deuteron energy at which the production of Cu^{62} was observed[1] is higher than the calculated threshold of reaction (4).

M. GOLDHABER.

Department of Physics,
University of Illinois,
Urbana, Illinois.
June 20.

[1] Krishnan and Banks, NATURE, **145**, 777 (1940).

[2] Krishnan and Gant, NATURE, **144**, 547 (1939).

[3] O'Neal and Goldhaber, *Phys. Rev.*, **57**, 1086 A (1940).

[4] Sagane, *Phys. Rev.*, **53**, 492 (1938).

[5] Salant and Ramsey, *Phys. Rev.*, **57**, 1075 A. (1940).

[6] Barkas, *Phys. Rev.*, **55**, 691 (1939).

Viscosity and Molecular Structure

TABLE 2 of our recent article in NATURE on "Viscosity and Molecular Structure"[1] contains some molecular weights of nitrocellulose and cellulose acetate estimated from viscosity measurements. One sentence of the text referring to this table runs: "in this case no experimental data from the ultracentrifuge were available".

Dr. E. O. Kraemer has been so kind as to direct our attention to the fact that (although the samples to which reference is made in the table have not been directly investigated by the ultracentrifuge) a number of other nitrocelluloses and cellulose acetates have been investigated by him[2] and by R. Signer[3] with the aid of the ultracentrifuge. We are greatly indebted to Dr. Kraemer for this comment, and wish to correct the remark in our article by adding: Ultracentrifuge measurements by E. O. Kraemer[2] gave, for cellulose acetate and nitrocellulose, molecular weights between 50,000 and 250,000 and between 102,000 and 160,000 respectively. It is also of importance to add that Dr. Kraemer, Dr. Signer and their collaborators have measured methyl and ethyl cellulose and have found values of 14,000–38,100 and 125,000 respectively.

Concerning the shape of proteins, data and formulæ presented by J. W. Mehl, J. L. Oncley and R. Simha[4,5] give better agreement between results obtained by viscosity measurements and those provided by the ultracentrifuge than that shown in Table 1.

Finally, we owe to Dr. Kraemer the information that the viscosity behaviour of gelatin at 34° investigated by Sanigar, Krejci, and Kraemer[6] is irreconcilable with the sedimentation constants, if the gelatin particles are assumed to be solvated spheres. The necessary degree of solvation would practically eliminate the difference between the densities of particle and medium.

H. MARK.
R. SIMHA.

c/o Nordeman Publishing Co., Inc.,
215 Fourth Avenue,
New York.

---

[1] NATURE, **145**, 571 (1940).

[2] Kraemer, E. O., *Ind. Eng. Chem.*, **30**, 1200 (1938).

[3] Signer, R., and Tavel, P. v., *Helv. chim. Acta*, **21**, 535 (1938). Comp. also Signer, R., and Liechti, J., *Helv. chim. Acta*, **21**, 530 (1938), and the data given in Svedberg and Pedersen's "The Ultracentrifuge" (Oxford, 1940), pages 416 and 431.

[4] Simha, R., *J. Phys. Chem.*, **44**, 25 (1940).

[5] Mehl, J. W., Oncley, J. L., and Simha, R., *Science* (in the press).

[6] Sanigar, E. B., Krejci, L. E., and Kraemer, E. O., *J. Amer. Chem. Soc.*, **60**, 757 (1938).

Camouflage in War-time

THE article on camouflage in NATURE of June 22 provides ample evidence of incompetence in this subject, but the writer has turned his guns in the wrong direction. His attack on artists has little relation to fact, in that the vast mass of 'camouflage' visible in all its glorious futility on army vehicles and buildings is not the work of artists.

A few weeks after the declaration of war a fellow artist, Mr. F. S. Manner, and I submitted a memorandum to the War Office camouflage authorities which covered all the criticisms mentioned in the article and a great many more. We are aware of at least one other memorandum on similar lines also submitted by an artist. We stressed the importance of biological study which, I am afraid, we called "Nature study", while pointing out the many occasions when it would be quite inapplicable. We also gave what we consider a practical solution to the whole question of co-ordination and control.

We also approached a Government contractor in relation to structural camouflage, and after some inquiry, he informed us that much of the work was in the hands of the Paint Manufacturers' Association. If this is so, it may be one of the reasons why khaki and green lozenges, of equal tone value, appear like a rash on everything that moves or stays in the military field. The artists at the Camouflage Research Station are probably equally sceptical about the situation, but what artist since the dawn of time has not obeyed the voice of the Philistine or said good-bye to his wage packet ? There is a strong case for employing display and exhibition artists rather than those accustomed to landscape and other forms of painting, because the former are used to designing structurally, and experts in getting almost any effect with the minimum material.

The artist should not be blamed for the present situation, however, because he is only too willing to co-operate with the biologist ; indeed he is no mean naturalist himself. Leonardo da Vinci, a great artist and scientist, pointed out Nature's use of protective colouring before Thayer was born. Artists before and since have been fully aware of the principles of 'countershading', 'coincident pattern', 'disruption', and 'deflection', only they have been called in art schools since the time of Rembrandt such other names as 'counterchange', 'discord and harmony', 'atmospheric and solid perspective'. Indeed, it is impossible to paint a picture without using these principles. Incidentally, no mention is made of the importance of aerial photography, which by using special film nullifies the virtue of colour, whether put on by naturalist or artist.

Let men of science turn their righteous indignation (an emotion impossible to the twisted cynicism of the artist) in the direction of the bureaucrats responsible for the control of camouflage. They will find the artists dour warriors in the same cause.

C. H. ROWE.

41 Camden Square,
London, N.W.1.

Cobalt and Pine Disease

IN a recent communication[1] Stewart and Ponsford have questioned the justification for our claim regarding the value of cobalt in the control of pine disease in sheep. We have examined the results which they have published[2], but find no evidence that they effect the validity of our conclusions.

It is unnecessary to go into details here, for a summary of the work carried out on the Scottish side of the border appeared last year[3] and shows that the use of cobalt for curative and preventive purposes has been widely adopted in the south of Scotland and in other areas with highly successful results. On farms where the treatment has been introduced on a systematic scale pine disease has been abolished. We have treated more than three hundred pining sheep by oral administration of cobalt on many different farms and the rate of recovery has been 97 per cent. The same treatment has been given by stock owners on the farms concerned with similar results. Sheep to which cobalt chloride has been administered have been kept for two years on pining land without a change of pasture and have remained entirely healthy.

Whatever may be the cause of this disease known as 'pining' on the Scottish borders, there now seems to be ample evidence that small doses of cobalt can cure or prevent it. It is possible that the experiments carried out by Stewart and Ponsford in Northumberland have been conducted under conditions which have become abnormal and have led to complications so that the use of cobalt alone is unavailing.

H. H. CORNER.
A. M. SMITH.

Edinburgh and East of Scotland
College of Agriculture,
13 George Square,
Edinburgh.

---

[1] NATURE, **145**, 1023 (1940).

[2] *Vet. Rec.*, **52**, 379 (1940).

[3] *Agric. Prog.* **16** 181 (1939).

RESEARCH ITEMS

Amerindian Religious Reactions to Cultural Impact

In a study of the ghost dance, which appeared among the Indians of Oregon and California in 1870, Cora Du Bois points out that it is a minor phase of a recurrent series of Messianic or revivalistic movements which have arisen among the weaker peoples throughout the world as reactionary waves to the crushing impact of European culture (*Anthrop. Rec.*, 3, 1; 1939. California Univ. Press). The ghost dance cult originated among the Paviotso of Walker Lake in Nevada in 1869–70; and from it developed a complicated series of cults during the sixty years beginning in 1871. The early manifestation consisted largely of doctrinal stress on the return of the dead and the end of the world, which in some vague supernatural way would entail the elimination of the white people. The ghost dance proper had two main strands of diffusion. Among the Wintun and Hill Patwin a further development was what is known as the earth lodge cult from its most characteristic feature. This cult stressed the end of the world. The faithful were to be protected from the catastrophe by the subterranean houses which they built for the purpose. Like the original ghost dance, this cult had two main strands of diffusion. An elaboration was the Bole-Maru, which abandoned the doctrines of imminent world catastrophe and stressed instead a concept of the after life and of the supreme being. Ceremonially its highest development occurred among the Patwin and Pomo. Each local dreamer had his own revelations and supernatural authority, which determined the form his cult activities should take. A probable dating indicates the origin of the ghost dance in 1869–70, diffusion beginning 1871, earth lodge cult 1871–72, Bole-Maru in its first form 1872, persisting, though in a state of flux, down to the present day.

Shrine and Market in Morocco

The saintly shrine of Sidī l-Yemām, a few miles south-east of Azila on the Laraiche-Tetuan road, typical of many in the countryside of Morocco described by Walter Fogg in *Man* of July, has a close relation to the nearby tribal market. The saint is said by tradition either to have come to Morocco with the founder of the first Mohammedan dynasty, or to have been a fighter against the infidel. Though his body lies in the grave, he is thought also to be alive. He is the patron of the countryside, and every year after the wheat harvest and threshing an important festival is held at the shrine in his honour, when much dancing, powder-play and feasting take place. Around the shrine is a large grove of old olive trees, each of which has much *baraka* (literally 'blessing', a wonder-working force). On certain of the trees fragments of clothing are tied as a means of placing *ar* on the saint, that is, the conditional curse which serves as a means of securing the fulfilment of a wish. The grove is also a haven of refuge. The spring is a 'haunted' and also a 'safe' spring, as opposed to a spring haunted by evil spirits. The tortoises, leeches and eels of the spring were 'holy', while the frogs, though not holy, might be inhabited by good spirits. Sacrifices were made at the spring as well as at the shrine itself, which was also the place at which solemn oaths were taken either between individuals or the representatives of two tribes after an intertribal war. In addition to the general significance of the shrine in relation to tribal life, which affected the market also, it had a particular reference for the latter. Not only was the spring the water supply of those attending the market—and holy at that; but also the market was under the special blessing of the saint, who walked about in the form of a visitor, or invisible, and his *baraka* protected buyer and seller alike. Everything bought at the market contained much *baraka* and might increase greatly in quantity after being stored, while the health and happiness of those attending will become greater from the influence of the saint.

Anti-Pernicious Anæmia Principle in Urine

In normal gastro-hæmopoiesis at least three unidentified factors appear to be involved. These are: (1) the 'intrinsic' factor of Castle or the 'hæmopoietin' of Wilkinson and Klein, which has enzyme-like properties and is present in the mucous membrane and secretion of the stomach and pylorus and reacts with (2) the 'extrinsic' factor of Castle such as beef protein, producing (3) the anti-pernicious anæmia principle absorbed from the intestine and stored chiefly in the liver. J. F. Wilkinson *et al.* (*Biochem. J.*, 34, 698; 1940) have now shown the anti-pernicious anæmia principle may be isolated from normal male urine or from urine of treated patients with remitting pernicious anæmia but not from urines of untreated relapsing cases of pernicious anæmia. The extracts, active by intramuscular injection, were obtained by either concentrating the urine by evaporation and precipitating inert material with alcohol or by adsorption of the active material on norite at *p*H 5. It is pointed out that if an accurate chemical or biological test for the anti-pernicious anæmia principle becomes available, by which relatively small amounts of urine can be assayed, then such a test may be of great value in the early diagnosis of the disease, since absence of the principle from the urine should be one of the first signs long before the blood picture becomes characteristic. It seems reasonable to suppose that the principle present in the urine is identical with the liver principle, and represents that which has been removed via the kidneys from the blood.

Corals of the John Murray Expedition

Vol. 6, No. 5 of the *Scientific Reports of the John Murray Expedition*, 1933–34, British Museum (Natural History), 1939, is noteworthy in having a special part (B) on the ecology of the solitary corals by J. Stanley Gardiner, besides Part A on the Madreporaria, excluding Flabellidæ and Turbinolidæ previously described, by the same author with Peggy Waugh. It is seldom that so full a statement is available of the difficulties which are encountered by the systematist when the group dealt with is subject to such extreme variation and so many environmental factors are involved. To determine the specific and even generic characters of these corals is a heart-breaking task, but one which has been much helped in the present instance by the large number of specimens of certain forms in the collection and a fair series of many, allowing a study of environmental variation in the species and a determination as to the characters which may be regarded as specific. Thirty-six species and sixteen genera are represented. Stress is laid on the fact that we do not yet know how the corallum is formed and the urgent need of this knowledge. A plea for the closer collaboration between geologist and biologist closes this interesting, if pessimistic, essay.

Taxonomy of the Actinomycetes

Two papers by E. Baldacci, relating to the systematic positions of ray fungi or Actinomycetes, have recently appeared in *Mycopathologia*. The first ("Introduzione allo studio degli Attinomiceti", vol. 2, fasc. 2, July 1939) is a comprehensive study of the whole family. A historical review of classification within this group reveals the need for a modern taxonomic framework to accommodate the research findings of recent years. This is met by a new classification, where the Actinomycetales are divided into two families with amended range, namely, Mycobacteriaceæ and Actinomycetaceæ. The former is further subdivided into Leptotrichioideæ and Proactinomycoideæ. Prof. Baldacci also proceeds to the finer divisions of classification in a further paper (vol. 2, fasc. 3; March 1940), where ten species of the genus Actinomyces are considered critically in the light of morphological and cultural behaviour. Subdivision into species has formerly been carried to excess, and several species described as new are now shown to be really strains of well-established specific conceptions.

Variegation in *Nicotiana Tabacum*

Among the monosomics (23II + 1) of *N. Tabacum*, the haplo-*C* type has been found to produce new types of the form 23II + C_1 + a fragment. These fragments are translocation products of the *P* and *C* chromosomes. The flower colour gene *Wh* is situated on the *C* chromosome. In an exceptional plant with flowers variegated carmine and white some cells contained 23II + C_1 + a fragment, while in others the fragment was missing. By propagating parts of the plant by the aid of hetero-auxin, K. R. Stino (*J. Hered.*, 31, 19–24; 1940) was able to show that the fragment was a ring-chromosome. Different cells contained rings of different sizes, or more than one ring. The behaviour of the ring-chromosomes appears to be, in general, similar to that of McClintock. The carmine-white variegation, therefore, is presumed to result from the loss of the *Wh* gene by breakage and deletion during the division of the ring-chromosome and sometimes to elimination of the ring-chromosome during mitosis. Sometimes the carmine sections were more intense than normal; this may be due to the presence of a double dose of the *Wh* gene. It is interesting to note that Clausen has now shown that the fragment in the classical case of the carmine-coral variegation is ring-shaped.

Colchicine Treatment of Daphnia

H. Howard Durham and A. M. Banta (*Genetics*, 25, 310–328; 1940) treated parthenogenetic eggs of a control line of *Daphnia longispina* with dilute solutions of colchicine. 60 unusual individuals occurred in 1748 treated eggs. Of these, 33 showed no ovarian activity, 20 produced parthenogenetic eggs which failed to hatch, while seven gave rise to mutant clones. Three of these mutant clones reverted to normal after several parthenogenetic generations. None of the eggs hatched from one line which was induced to reproduce sexually. There was no evidence of polyploidy, and the nature of the changes brought about by colchicine in Daphnia await further elucidation.

Temperature Distribution in the Lower Stratosphere

A discussion entitled "Distribution of Temperature in the Lower Stratosphere" by M. W. Chiplonkar deals with the increase of temperature with height that has been observed in India between heights of about 18 and 25 kilometres (*Proc. Ind. Acad. Sci.*, **11**, No. 1, Sec. A; 1940). The India Meteorological Department has been very successful in obtaining observations of temperature at great heights, and the author had for his purpose ten soundings from Poona (latitude 18°) and sixteen for Agra (latitude 27°). All except four of these twenty-six ascents were made during the period November–April, and many at such a time that the sun was probably below the horizon when the balloon passed into the stratosphere. These last must therefore have been unaffected by solar radiation. It appears that no other country can show a comparable number of very high soundings free from this only too likely source of error. The increase of temperature between 18 and 25 kilometres over Poona is largest around 21 kilometres, where it amounts on an average to between 4° and 5° C. per kilometre. It appears to be a permanent feature of the stratosphere over tropical India. Comparison is made with Munich (48° N.) and Abisko (68° N.), where an analogous rise is shown; but one which begins at a lower level, is much smaller, and is confined to the summer half of the year. The view is taken that in those European ascents that were made with the sun above the horizon the variation of temperature with height was probably little affected, although the level of temperature probably was affected. A short summary of some present-day views about the causes of the distribution of temperature within the stratosphere is added.

Investigation of the Period of RW Sagittarii

P. M. Ryves has discussed his observations of RW Sagittarii since 1923 (*Mon. Not. Roy. Astro. Soc.*, 100, 6; April 1940). Ryves suggested in 1923 (*Mon. Not. Roy. Astro. Soc.*, 84, 34; 1923) that it was a variable star of long-period type and small amplitude, the extreme range being 2·1 magnitudes and period 188 days. Although a large portion of his observations from 1923 is inaccessible owing to the international situation, it has been found possible to discuss some provisional data. From a re-examination of the earlier work in conjunction with some of the later observations, it seems that the period of 188 days satisfies the observations up to 1926 or 1927. After 1926 the observed dates of minima commenced to lag behind the calculated dates by increasing quantities, and a period of 191 days satisfied the later observations, but greater precision will not be attempted nor will the light-curve be fully described until all the observations can be used, The change of period appeared to have been effected abruptly about cycle 30 or 31 (1925–26), and about this time the light-curve showed peculiar irregularities, including indications of a second wave or inflection with a period of about 172 days, and a superimposed short-term variation, period 22 days.

THE ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THIS year the fellows of the Royal Society of Canada were the guests of the University of Western Ontario in London, for their annual meeting during May 20–22. The attendance was not so large as last year; but representatives from all parts of Canada attended and presented papers. The University buildings, situated in beautiful spacious grounds outside the city, presented a peaceful contrast to the present conditions in Europe.

The presidential address, "A Study of the Organization and Work of the Royal Society of Canada", was delivered by Dr. H. M. Tory, following a complimentary dinner tendered the fellows, their wives and guests, by the City of London on May 20. The president stated that the Royal Society of Canada differs in one respect from the similar Society in England, in that it includes under its organization all the intellectual movements which were deemed worthy of recognition. Thus with the Natural Science Sections III, IV and V are associated the Literary Sections including philosophy, literature, history and economics. After outlining the various contributions of the older sciences and literary fields of knowledge to our present Western society, Dr. Tory concluded with the suggestion that they should at their annual meeting each year have a major symposium dealing in some form with the relations existing between the various sections. Two typical topics suggested were the effect of science upon literature in the last hundred years and the present state of controversy between science and philosophy.

On May 21, Dr. R. W. Boyle received the Flavelle Medal of the Society for distinction in scientific subjects, in recognition of his researches, particularly on the development of 'Asdics' and his work on ultrasonics. The presentation of the medals was followed by a scholarly lecture delivered by Dr. F. Cyril James, principal of McGill University, on "Science and Society", in which he traced the changes in Western society brought about in the four centuries between 1475 and 1875 due to the impact of scientific discovery. He pointed out that the primary function of the social sciences is the charting for society of a course that is most appropriate in the light of the existing fund of human knowledge. Apparently the impact of science on society has not been wholly beneficial; the ethos of Western society has not responded to the changes in its material environment, but if we are willing to face the major problem of deciding upon our ideals, the forces that science has placed at our disposal are sufficient to make the attainment of those ideals a practical possibility.

Section III (Chemical, Mathematical and Physical Sciences) was held under the presidency of Prof. J. A. Gray, who delivered the presidential address on "Studies in Beta and Gamma Rays", in which he outlined the early work done in Rutherford's laboratory at Manchester and the subsequent development of the theory of scattering and softening of the γ-rays on passing through matter. Recent experimental results on the beta-ray spectra and the gamma-rays from uranium X were presented by Dr. Gray. Five new fellows were elected to the Section: Dr. A. N. Campbell, Prof. P. E. Gagnon, Prof. Gordon Pall, Dr. R. M. Petrie and Prof. H. Grayson Smith.

Of the eighty-four papers presented to Section III, twenty-five were by title. Dr. S. A. Hodgson described the seismograph installation at the Lake Shore Mines, Kirkland Lake, Ont., and the results obtained in investigating the possibility of forecasting the rock bursts which are prevalent in that mine. The results of experiments on the vibrations in aircraft, described by Dr. D. C. Rose, indicated the possibility of improvement in the design of such craft. Dr. J. S. Foster reported that he and his associates had obtained some new results in the Stark effect, using copper, nickel, mercury, zinc, cadmium, and lead, and fields from 100 to 250 kv./cm. R. G. Elson, Grayson Smith and J. O. Wilhelm described a new type of calorimeter for determining the specific heats of materials at liquid hydrogen temperatures. Among the results communicated, it was stated that the variation with temperature of the specific heat of manganese can be expressed by a Debye function with a characteristic temperature of 410° and a linear term $0{\cdot}0042\,T$.

A very interesting investigation on the validity of the Ferry-Porter law in normal, enhanced and depressed states of visual sensibility, and the influence of stimulation of the senses of vision, hearing, taste and smell upon the sensibility of the organs of vision were reported by Dr. Frank Allen. It appears that stimulation of one sense causes a periodic rise and fall in another, the results confirming and extending the work of Kravkov. For example, stimulation of the ear by sounds makes red colours appear dimmer and green brighter when no rest interval is allowed, but after a rest interval of three minutes, the red appears brighter and the green dimmer. A number of papers on meteorology by the staff of the Meteorological Office were communicated by the director, John Patterson, who exhibited a new *radio-sonde* instrument by R. C. Jacobsen, now being used by the Service. Dr. L. Gilchrist described geophysical results of electrical drill hole coring carried out with the assistance of A. R. Clark, and Dr. D. A. Keys gave the results of a magnetic survey on Calumet Island. Dr. D. K. Froman described a 12-inch cloud chamber used in a magnetic field for the study of cosmic-ray mesotrons.

Among the fourteen mathematical papers read, Dr. Buchanan spoke on second genus crossed orbits, in which he considered a special case of the restricted three-body problem. Dr. R. L. Jeffery gave a paper on the integration of functions in a complete normed sector space, in which he set forth a theory equivalent to that of G. Birkhoff.

Dr. Gordon Pall delivered a paper on "Simultaneous Representation in Quadratic and Linear Forms", and among several papers read by Prof. Synge attention is directed to a new electromagnetic energy tensor. A direct application of the laws of conservation of energy and momentum leads to the equations of motion given by the Lorentz ponderomotive force, without the radiation term. Dr. W. L. G. Williams communicated the results of an investigation on hyperbolic trigonometry.

In the Chemistry Section, Dr. E. W. R. Steacie and his students presented five papers on photosensitized reactions, in which the polymerization of ethylene was investigated using different wave-lengths in the ultra-violet, and an estimate of the strength of the C–H bond was determined. Dr. P. Gagnon described the synthesis of some new hydrocarbons in the indene series, and Dr. R. H. F. Manske described the structure of hunnemanine. A large number of papers were read by Dr. R. H. Clark and his students. An examination of the phenolic constituents of the water-soluble ethanolysis products of western red cedar, Douglas fir and western hemlock was made, and the oil isolated from the phenolic constituent in each case on methylation with diazomethane yielded a white crystalline compound with the same melting point as that from spruce and maple woods. Another paper described a method for the synthesis and isolation of glycuronic acid.

Prof. Otto Maass was elected president of Section III and Prof. J. K. Robertson secretary.

The feature of the meetings in Section IV (Geological Sciences) was the excellent address of the president, Prof. J. J. O'Neill, on "The Exploitation and Conservation of Mineral Resources in a Balanced Development of Canada". He urged that while the mines are active in Canada's north, bringing men and money into the country, is the time to take preliminary steps toward permanent settlement; otherwise when mines are exhausted the settlements will be deserted and become 'ghost towns'. Each district will have to be considered as an individual problem, and study of these problems should be begun at once. Agriculture in the few areas possible, reforestation to be followed eventually by scientific lumbering, and the development of manufacturing industries near sources of power were some of the possibilities suggested.

Among the twenty-eight papers presented, special mention may be made of one by P. M. Hurley, C. Goodman and R. D. Evans on the investigations of the helium method of age determination. They show that the agreement between the results obtained using samples of pyroxene from specimens is much better than that obtained from determining the age from felspar. It is suggested that pyroxene retains its helium and is more suitable for such age determinations. Dr. A. E. Gill directed attention to the unsatisfactory state of fault nomenclature and suggested certain improvements. As a result, a committee was appointed to study the question and report at the next meeting. J. T. Wilson summarized the results of a study of air photographs covering a large belt of the North-West Territories. The investigation showed this part of the Canadian Shield to be a mosaic of fault blocks, some having horizontal movements as much as eighteen miles.

The presidential address of Section V (Biological and Medical Sciences), entitled "The Causes of Hybrid Sterility and Incompatibility", was delivered by Prof. W. P. Thompson, of the University of Saskatchewan, and stressed particularly the time in the life-cycle at which the causes may operate.

A notable feature of the meeting was the group of papers on fish (and particularly on salmon). Prof. A. G. Huntsman described the habits of Atlantic salmon and discussed deaths due to high-water temperatures in the rivers of eastern Canada, while Prof. E. M. Walker presented the work of K. C. Fisher and P. E. Elson on temperature preference in Atlantic salmon and speckled trout. W. A. Clemens reported A. L. Pritchard's work on the age of coho and spring salmon of British Columbia and his own work on sockeye salmon in the same region. Attempts to explain the origin of kokanee (a variety of sockeye salmon) were made in a paper by W. E. Ricker, reported by R. E. Foerster. The close affinities of the Coregine fishes of Canada with Siberian species were dealt with by J. R. Dymond.

Desiccation in southern Ontario, as reflected in the decreasing mileage of streams, was the subject of a paper by A. F. Coventry, read by J. R. Dymond. This lead to an animated discussion as to the causes of desiccation.

Botanical papers included one by Prof. R. B. Thomson on the study of sporelings in the vascular cryptogams as a basis for the interpretation of seedling organization, another by H. B. Sifton on the development of the air spaces in the leaf of Labrador tea, and two by Prof. E. H. Moss on interxylary cork in Artemisia. Prof. G. W. Scarth summarized work on frost- and drought-resistance carried out with J. Levitt, B. Siminovitch and others and described the changes in the physical state of protoplasm associated with hardening.

James Miller discussed the parts played by the basal and prickle layers of the epidermis in regeneration and neoplasia, and M. L. Barr described the effect on the synapse of axon reactions in motor neurones. C. C. Macklin demonstrated that after over-inflation of the excised lung the internal septa and sheaths of the pulmonary blood vessels are similarly pneumatized. Dr. Benjamin Kropp brought forward much material to demonstrate that in spontaneous and therapeutic abortions structural abnormalities were present in the villus capillaries and villus epithelium. H. Wasteneys, B. F. Crocker and P. Hamilton reported that deuterium-labelled proteins are useful for the study of digestion in the dog. Madge Thurlow Macklin gave evidence that tumours in man have a genetic basis, and Lionel Penrose presented studies on the grandchildren of consanguineous unions. Dr. D. A. Scott discussed the structure of insulin crystals prepared from bison and human pancreases in comparison with those previously prepared from other sources. Dr. Leslie Young described his synthesis of aryl hydrogen sulphates *in vitro*.

Drs. Clark, Cleghorn, Ferguson and Fowler demonstrated that adrenal insufficiency results in a decrease in extracellular fluid and in plasma volume, that the percentage decrease of the former is less than the latter and that the decrease in plasma was not sufficient to account for circulatory collapse. Dr. Bram Rose presented evidence to show that in various types of shock there is a decrease in blood histamine. Dr. N. W. Roome advanced further evidence tending to dissociate the sympathetic nervous system from shock due to hæmorrhage. Prof. F. R. Miller demonstrated the local effects of eserine and acetylcholine on the electrogram of the cerebellar cortex. Dr. P. J. Maloney presented further evidences of the influence of bile salts on the flocculation of toxin. Prof. G. B. Reed described a semi-synthetic medium for the production of gas gangrene and tetanus toxins.

E. Horne Craigie described the area of distribution of the middle cerebral artery in birds and the form of the capillary bed of the central nervous system in Dermophis. J. McDunnough discussed some marine Coleophoridæ, and C. McLean Fraser described hydroids of the Pacific coast.

Other papers dealt with genetics of size (J. W. MacArthur) and the structure of homotypic and somatic chromosomes (L. C. Coleman).

Principal R. C. Wallace, of Queen's University, was elected president of the Society for the ensuing year.

CULTURE *IN VITRO* OF THE EXCISED EMBRYO OF AN OPHIUROID

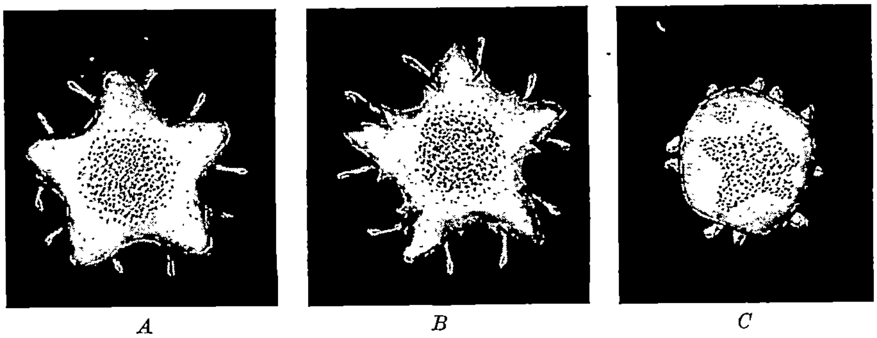
By H. Barraclough Fell,
Department of Zoology, University of Edinburgh

EXCISED embryos of the viviparous ophiuroid *Amphipholis squamata* have been successfully cultured *in vitro* by the method described below. It has been developed in the course of a study of the embryology of the species, and involves a modification of the watch-glass technique of Strangeways as described by Honor B. Fell and Robison[1]. As the culture medium Föyn's "Erdschreiber" has been used; this fluid has been employed previously by Dr. F. Gross for culturing the post-embryonic stages of fish, and various larvæ, and I am indebted to him for suggesting its use in the present instance.

The pregnant adult is anæsthetized by subjection to a solution of menthol in sea water. The embryos are excised from the bursæ and pipetted through several washings of sea water which has been sterilized. Each embryo is then placed in a small watch-glass (5 cm. diameter) and covered by 2–3 c.c. Erdschreiber medium, prepared as described by Gross[2] (p. 754). The watch-glass is set in a larger Petri dish, together with a sterile swab of wet cotton wool to keep the contained air humid, thus minimizing changes in the density of the culture medium through evaporation. The whole 'set-up' is surrounded by a bath of flowing tap water to keep the temperature reasonably constant. In practice, the medium has been renewed every fourth day, but a longer interval can be allowed. Aseptic technique must be used throughout, as the embryos are very susceptible to bacterial toxins. Embryos treated in this way have continued to grow and to differentiate in the usual way as if still within the bursæ of the parent, but with the advantage that the developmental changes can be observed in sequence.

The value of Erdschreiber as a medium for the culture *in vitro* of explanted embryos is demonstrated by the behaviour of controls cultured in the same way, but using as the culture medium sterile sea water which has been allowed to regain its normal oxygen content and *p*H value after sterilization. Freshly explanted embryos so treated appeared healthy and active until the sixth day, when it was observable that the yolk-mass, which is normally confined to the mesendoderm region, was assuming an irregular distribution through the tissues. The movements of the podia were feebler. On the seventh day the embryos had withdrawn the arm-buds and begun to assume a spherical form. Feeble movements of the podia still occurred, but they were shrunken and no longer capable of being used as organs of progression. By the eighth day one of the embryos had assumed the form of a ball of undifferentiated cells from which the vestiges of the podia protruded. In another embryo the cells of the disk had begun to grow out independently as in an ordinary tissue culture, and this condition persisted to the sixteenth day, when death occurred. On the other hand, embryos which had been placed in Erdschreiber at the beginning of the experiment had by the eighth day undergone considerable differentiation, and were moving about actively on the floors of the watch-glasses.

An embryo which had undergone retrograde development in sterile sea water was placed in Erdschreiber on the eighth day. The tissues, however, failed to redifferentiate, and after a period of unco-ordinated cell-division, death occurred.



A. Embryo when removed from the bursa. *B*. Same embryo after eight days culture in Erdschreiber, showing growth and differentiation of the arms. *C*. Retrograde development of another embryo after eight days in sterile sea water, having been at the same stage as *A* when removed from the bursa.

The development of the embryo will be described later elsewhere. It may, however, be stated here that a comparison of the results of culturing embryos in Erdschreiber and in sterile sea water shows that the embryo is unable to develop on its own yolk material alone, requiring the addition of other substances to the medium. These substances, whatever they may be, are contained in Erdschreiber (an aqueous extract of earth by autoclaving, plus sodium nitrate and disodium hydrogen phosphate). Therefore, we are justified in concluding that the wall of the bursa secretes a nutrient substance which is directly absorbed by the embryo within. This deduction is in agreement with the fact that the bursal wall contains numerous sinuses. In the absence of the necessary substance or substances, the embryo remains for a while apparently healthy, and then undergoes a retrograde development, resulting finally in an amorphous mass of cells. The fact is interesting in that it indicates the closeness of the interrelationship that can exist between parent and embryo in the echinoderms.

---

[1] Fell, Honor B., and Robison, R., "The Growth, Development and Phosphatase Activity of Embryonic Avian Femora and Limb-buds Cultivated *in vitro*", *Biochem. J.*, 23, 4 (1929).

[2] Gross, F., "Notes on the Culture of some Marine Plankton Organisms", *J. Mar. Biol. Assoc.*, 21, 2 (1937).

STEREOPHONIC RECORDINGS OF ENHANCED MUSIC

DEMONSTRATIONS of the stereophonic reproduction of music and speech were given at the Carnegie Hall in New York City on April 9 and 10. This was the culmination of a long series of researches by Bell Telephone Laboratories. The first step in this achievement was demonstrated in 1933, when a symphony concert produced in Philadelphia was transmitted over telephone wires to Washington and there reproduced stereophonically and with enhancement before the National Academy of Sciences. Subsequent researches by Dr. H. Fletcher and his colleagues at the Bell Laboratories have supplied the equipment and technique for recording such a production on film.

With the co-operation of Leopold Stokowski and the Philadelphia Orchestra, the Tabernacle Choir and organists in Salt Lake City, and of Paul Robeson and other artists, their music and drama was recorded both in Philadelphia and in Salt Lake City. At a later audition, the director or artist was able to vary the recorded volume and to change the tonal colour of the music to suit his taste. He could soften it to the faintest pianissimo or amplify it to a volume ten times that of any orchestra without altering its tone quality, or he could augment or reduce the high or low pitches independently. While he was thus enhancing the music which he himself had directed, his interpretation was being re-recorded on film as a permanent record.

Selections for reproduction, chosen to demonstrate the full capabilities of this system, were given. From the choral numbers, vocal solos, organ, drums and grand opera reproduced at Carnegie Hall, the audience gained an idea of the versatility of the stereophonic system. A stirring climax for the programme was provided by the closing scene of the "Götterdämmerung". Dr. Stokowski took full advantage of the tenfold increase of sound over that of the largest orchestra, and effectively used the individual control to make the soloists' voice clearly heard above the orchestra. Dr. Stokowski has shown a full grasp of the possibilities of the new system.

In the *New York World Telegraph* of April 10, L. Biancolli describes a new effect demonstrated at Carnegie Hall. When the light went out all that one saw was a gossamer veil hung across the stage, with a soft red glow playing on it. Then a flute sounded thinly from the distance; a crowd bellowed thunderously; horses galloped by; thunder rumbled; a man talked as he walked from one end of the stage to the other. Then the whole width, breadth and depth of a symphony orchestra went into action. It sounded real, spread out in space. But it all came from a set of sound boxes and horns each functioning separately and in unison. "Dogged research in electricity, acoustics, dynamics had shown one more miracle—spread-out sound coming straight from the source, with no hint of crowding. Drums were at one end, flutes at another and in between other instruments were heard clearly across the stage. There was no blurring, no congestion. Pianissimi were the merest hush and fortissimi had the impact of a cannonade. The trick of giving orchestral music 'position' in recordings and weaving in nuances between nuances is now a perfected fact."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CIVIL ENGINEERING ASSISTANT—The Waterworks Engineer, Town Hall, Wakefield (August 8).

TEACHER OF MECHANICAL ENGINEERING at the Smethwick Municipal College—The Chief Education Officer, 215 High Street, Smethwick.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Experimental and Research Station, Nursery and Market Garden Industries Development Society, Ltd., Cheshunt. Twenty-fifth Annual Report, 1939. Pp. 60. (Cheshunt: Nursery and Market Garden Industries Development Society, Ltd.) [97

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 799, Vol. 239: The Friction of Lubricated Metals. By F. P. Bowden and L. Leben. Pp. 27+5 plates. 8*s.* 6*d.* Series B: Biological Sciences. No. 571, Vol. 230: On the Evolution of the Mammalian Palate. By F. R. Parrington and Dr. T. S. Mestoll. Pp. 305–355. 8*s.* (London: Cambridge University Press.) [117

Other Countries

Bulletin of the American Museum of Natura History. Vol. 77, Art. 2: A Supplement to the American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name. Pp. 109–142. (New York: American Museum of Natural History.) [87

Proceedings of the United States National Museum. Vol. 87, No. 3076: Catalog of Human Crania in the United States National Museum Collections—Indians of the Gulf States. By Aleš Hrdlička. Pp. 315–464. (Washington, D.C.: Government Printing Office.) [87

Report for the Year 1939 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 10. (Cape of Good Hope: Royal Observatory.) [107

Union of South Africa: Department of Agriculture and Forestry. Pamphlet No. 215 (Chemistry Series No. 161): The Bambarra Groundnut or Njugo Bean. By J. M. Holm and Dr. B. W. Marloth. Pp. 10. (Pretoria: Government Printer.) 3*d.* [107

Survey of India. General Report 1939, from 1st October 1938 to 30th September 1939. Pp. xii+83+8 plates+7 maps. (Calcutta: Survey of India.) 1·8 rupees; 2*s.* 6*d.* [117

Triennial Programme of Work for the Forest Research Institute, Dehra Dun, for 1939–42. Pp. 32. (New Delhi: Government of India Press.) [117

Smithsonian Miscellaneous Collections. Vol. 99, No. 4: A Check-List of the Fossil Birds of North America. By Alexander Wetmore. (Publication 3587.) Pp. ii+81. Vol. 99, No. 5: The 11-Year and 27-Day Solar Periods in Meteorology. By H. Helm Clayton. (Publication 3589.) Pp. ii+20. (Washington, D.C.: Smithsonian Institution.) [117

U.S. Department of Agriculture. Circular No. 568: Factors Influencing the Use of some Common Insecticide-Dispersing Agents By Lynn H. Dawsey. Pp. 10. 5 cents. Yearbook Separate No. 1718 Feeding Requirements of Gallinaceous Upland Game Birds. By Ralph B. Nestler. Pp. 893–924. (Washington, D.C.: Government Printing Office.) [117

U.S. Department of the Interior: Office of Education. Know Your School Leaflet No. 53: Know how your Schools are Financed. By Timon Covert. Pp. iii+17. 5 cents. Pamphlet No. 89: Opportunities for the Preparation of Teachers in the use of Visual Aids in Instruction. By Katherine M. Cook and Florence E. Reynolds. Pp. iii+13. 5 cents. Pamphlet No. 90: Opportunities for the Preparation of Teachers in Conservation Education. By Katherine M. Cook and Florence E. Reynolds. Pp. iii+13. 5 cents. Vocational Division Bulletin No. 205 (Business Education Series No. 12): Co-operative Part-Time Retail Training Programs; Supervision, Co-ordination and Teaching. By Kenneth B. Haas. Pp. vii+96. 15 cents. (Washington, D.C.: Government Printing Office.) [117

New York Zoological Society. Report of the Director of the Aquarium. Pp. 30. (New York: New York Zoological Society.) [117

Tanganyika Territory: Department of Tsetse Research. Tsetse Research Report, 1935–1938. Pp. 88. (Dar es Salaam: Government Printer.) 5*s.* [117

Some Problems of the New World Order. By Dr. G. H. Scholefield (Cawthron Lecture, 1939.) Pp. 29. (Nelson: Cawthron Institute.) [117

Trinity College Bulletin. Vol. 37, New Series, No. 2: A List of Books for a College Student's Reading. Edited by Prof. Harry Todd Costello. Third edition, rewritten. Pp. 125. (Hartford, Conn.: Trinity College.) [117

University of Washington Publications in Anthropology. Vol. 8, No. 2: Coos Myth Texts. By Melville Jacobs. Pp. 127–260. (Seattle, Wash.: University of Washington.) [127

University of Illinois: Engineering Experiment Station. Bulletin No. 321: Summer Cooling in the Research Residence with a Condensing Unit operated at Two Capacities. By Prof. Alonzo P. Kratz, Prof. Seichi Konzo, Prof. Maurice K. Fahnestock and Edwin L. Broderick. Pp. 70. 70 cents. Bulletin No. 322: An Investigation of Rigid Frame Bridges, Part 3: Tests of Structural Hinges of Reinforced Concrete. By Ralph W. Kluge. Pp. 34. 40 cents. (Urbana, Ill.: University of Illinois.) [157

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 10, 1940 No. 3693

THE CHALLENGE OF SCIENCE

THE widespread utilization of science in both offensive and defensive warfare has brought into fresh prominence the old question whether science is a curse or a blessing. Such a discussion cannot even in these times be dismissed as purely academic. Behind many of the problems with which we are concerned in the war effort, such as food production and factory welfare, lies the major question confronting Western society to-day, that of harnessing science to human welfare. The misuse of discoveries and inventions must not be allowed to obscure their beneficent effects. As Prof. J. C. Philip pointed out in his recent presidential address to the Society of Chemical Industry, inventions, materials and machines are not in themselves good or evil; the character of the part they play in the human drama is determined by man himself, and the tragedy is due to human weakness and failure.

On this, recent events in France may well make a vivid commentary. There is no need to subscribe to the view that widespread appreciation of science and better systematizing of human knowledge offer a panacea for the ills and maladjustments of humanity. But abandonment of extravagant claims on behalf of science does not affect the tremendous opportunities of using it as a tool for the benefit of humanity. The tragedy lies in that men have looked backward instead of forward. Realizing that neither physical science nor industry are ends in themselves and that material things cannot be allowed to dominate human life, they have sometimes thought they should be ignored—that because ends are more than means, means are of no account.

Scientific workers may well be grateful for Viscount Samuel's words on this subject in his Messel Lecture, "Science and Civilization", before the Society of Chemical Industry on July 9. Applied science, he asserts, is worth while not only for what its achievements are in themselves but also for the sake of the ends they make possible. To blame science for the present war is unreasonable; as though there had been no warfare before the age of science. Even if the humane nations were to restrict or abolish industrial science, as an accessory to the crimes of war, we may be sure the inhuman nations would not. We cannot leave Justice with only her ancient sword to face Injustice armed with machine-gun and grenades.

A wider view, therefore, urges Viscount Samuel, will dispose of the hasty judgment that the world would be the better if it sought to discard the scientific altogether, and went back to the primitive. On the contrary, while recognizing that it should seek no monopoly in our activities, or even predominance, science, vindicated in its purposes, may rightly ask from society as a whole the conditions that will best develop its efficiency and ensure its success in tasks that are beneficent and indispensable.

A full realization of the possibilities which science has put into our hands, not merely in regard to production and leisure, but also through the lengthening of human life by the control of disease, the removal of the environmental causes in early life of many of the physical, mental and spiritual defects from which we suffer, as revealed by the new sciences of nutrition, eugenics and psychology, and the development of man's latent capacities of greatness and goodness, might well, as Sir John Orr has urged, prove a decisive factor in the development of some new system of world order. What is essential is that men should face the development of the new order with the same courage, the same confidence and willingness to venture as they are displaying in the prosecution of the War.

A timely and valuable contribution to the discussion has been provided by Prof. H. Levy in a recent pamphlet.* Prof. Levy takes the view that lack of courage has been shown by many educated men and women who have realized the creative power which science has placed in their hands and yet are conscious of the havoc and destruction to which that power has been turned. The turning to mysticism is a turning away from a contribution to the reasoned understanding of the forces of Nature. It is failure at a critical moment in world history to concentrate the mind and brain-power of men on vital problems the solution of which is so urgent that every ounce of thought should be directed to their analysis. It is akin to the defeatism and moral paralysis which have contributed so largely to the overthrow of France.

This, as Prof. Levy points out, is treachery indeed to science, and deals a staggering blow to humanity. When men need strength and self-reliance they are offered insecurity ; when men require to face realities they are offered illusions, presented in the terms of those branches of science most remote from the common understanding, trading on popular ignorance and exploiting popular fear and interest in the mysterious. It is this confusion, for which some men of science must share the responsibility, that has hindered the forward view, the resolute shaping of policy and the fruitful impact of science on philosophy itself.

Scientific laws have a twofold aspect which is apt to be overlooked at this time of confusion. There are laws of order and laws of accident as well, and even accidents taken in the mass can be studied systematically. If philosophy is to base itself on the fullest knowledge, it must begin with the established findings of science. It must see the historical evolution of men and the tentative nature of their knowledge. It must adopt the experimental method with regard to the discovery of new generalizations, and learn how to avoid the dangers involved in false formulations of its problems.

Prof. Levy rightly emphasizes this philosophical aspect, for here can be found the corrective to the narrow perspective which is one of the dangers to be guarded against in a struggle like the present, with its tremendous demands upon our energy and thought. It is not the least of the merits of his pamphlet that it assists us to view the struggle itself in a wider and truer perspective which may well fortify our resolution and inspire us with fresh devotion.

The coming of this catastrophe, Prof. Levy suggests, is, from the point of view of the utilization of science, the climax to a process of human and scientific frustration that had rapidly been making itself apparent for almost a generation, just when the most striking advances were being made in almost all branches of physics, chemistry and biology.

We have now to recognize that concentration on war-time problems has shut down almost completely what might be called the cultural side, and the more barbaric side has become dominant. If this position reminds us that science itself is an aspect of social change, and must bend to the more compelling social demand, and that the direction of scientific advance must align itself with needs other than those of the internal logic of the scientific subject itself, there are at least elements of hope in the situation.

It is no matter for regret that the false idea that science is an independent discipline of its own, owing nothing and giving nothing to society, should be exploded. Moreover, some of the war-time problems have emphasized the urgent need for scientific knowledge and further research at precisely those points in the front of science where we had already become aware that the uneven advance was handicapping scientific as well as social development. The survey of man-power at present being conducted by Sir William Beveridge will unquestionably be assisted by the studies of the location of industry already conducted by P E P (Political and Economic Planning) and by the report of the Royal Commission on the Distribution of the Industrial Population The requirements of civil defence and now of defence against invasion have underlined the arguments in such reports in favour of co-ordination and regionalism, and many important problems in local government, decentralization and the like, have been raised, the solution of which on rational lines to meet war emergencies may well clear the way for further advance later.

Besides this, evacuation questions have emphasized the need for more sociological research and may well give an impetus to many much needed investigations. The scientific study of th question of food supply and production is now being undertaken on a much more adequate basis, and the elaboration of policy and measures designed to ensure at least an adequate 'iron ration' for the whole population may not only lead to the more scientific utilization of our resources but also to the further advance of agricultural and horticultural science, and to a frontal attack on the problems of malnutrition and under-nourishment. Other problems or needs of war-time have strengthened forces making for a more intensive attack on problems of disease or other matters of public health.

---

*Science—Curse or Blessing? By Prof. H. Levy. (Thinkers Forum, 4.) Pp. 48. (London: Watts and Co., Ltd., 1940.) 6d. net.

Preoccupation with the effort required to prosecute the War should not therefore lead us to overlook the fact that in the profound changes involved new opportunities and possibilities are opening up before us. Vested interests or embedded prejudices that have long blocked progress are being compelled to yield before national exigencies, and we should not allow them again to hold up social or scientific advance when the War has been won. The period of scientific frustration through which we have passed is evidence of the inability of the old system to avail itself constructively of the new knowledge to usher in a new level of social life. Repression of progressive ideas, whether in Fascist or in Democratic countries, is treason to science no less than to civilization and the abiding values of man's cultural and moral heritage.

This is indeed one of our gravest dangers—that our condemnation of War itself or concentration on immediate war tasks should lead us into the company of those who cannot believe that Europe is in the throes of the birth-pangs of a new society in which they are called to play an entirely new part. The chances which the War itself offers us of ultimately building a new and better world order will not be used by those whose minds are set in old-established grooves or are afraid to face new situations and use new methods.

Whether science is a curse or a blessing depends fundamentally on whether we are prepared to meet the challenge which it throws down to us in economic and in moral affairs. The individual basis for conduct in a modern complex society is inadequate. We have to face the reorganization and reorientation of industry, of society, and of ethics itself, on a social as well as an individual basis, if our democratic institutions are to stand the strain which is thrown on them now that science and its technical applications, by binding groups together as entities, have made them socially and economically interdependent.

The issue depends largely on whether we bring to that task a width of vision and openness of mind, a firmness of purpose and a courage and comradeship commensurate with those demanded of us in this present hour of trial. It also depends on whether even now we are prepared to undertake the preliminary thought and investigation, the linking up of the war effort with the task of reconstruction, so that the opportunity to rebuild when it comes to us is not missed for lack of vision or preparation as it was two decades ago.

A NEW TRANSLATION OF THE TELL EL-AMARNA LETTERS

The Tell el-Amarna Tablets
Edited by Prof. Samuel A. B. Mercer, with the assistance of Prof. Frank Hudson Hallock in the final revision of the Manuscript. Luxor edition. 2 vols. Vol. 1. Pp. xxiv+442. Vol. 2. Pp. iv+443–910. (Toronto: The Macmillan Company of Canada, Ltd., 1939). 84*s*. net.

IT is fifty-three years since the famous collection of cuneiform tablets known as the Tell el-Amarna Letters was discovered on the site of the ancient capital of Amenophis IV, better known as Akhnaton, the 'heretic' Pharaoh. Twenty-eight years after the discovery, a careful edition of the text, with translation, notes and glossary, was produced in German by Knudtzon, with the collaboration of Weber and Ebeling. In the interval an edition, of a somewhat provisional nature, had been published by Hugo Winckler, and translated into English by Mr. J. M. P. Metcalf, in 1896. But, until the appearance of the present edition from the hand of Prof. Mercer, English scholarship has produced no independent edition of these most important documents.

This is not to say that the Tell el-Amarna Letters have been ignored by English scholars, as may be seen from such studies as the late Prof. Burney's Schweich lectures on Israelite settlement in Canaan, and Prof. S. A. Cook's admirable chapter on Syria and Palestine in the light of external evidence, in the second volume of the "Cambridge Ancient History". But Prof. Burney's book was written in 1917, and volume 2 of the "Cambridge Ancient History" appeared in 1924, so that a quarter of a century has elapsed since the last authoritative discussion of the significance of these documents from the pen of any English scholar.

Meanwhile, great advances have been made in our knowledge of the history and civilization of the ancient Near East. The archives of Boghazköi have been unsealed at last, throwing a flood of new light on the history of the great Hittite Empire during the first half of the second millennium B.C. The publication of the texts from Nuzi and Kirkuk, the discoveries at Ras Shamra, the site of the ancient city of Ugarit, mentioned in the Tell el-Amarna correspondence, M. Parrot's excavations at Mari, Sir Leonard Woolley's results from the excavation of Atchana, and Mr. Mallowan's recent work at Brak, have all combined to illuminate many problems raised since the appearance of the Tell el-Amarna Letters.

Hence it was full time to attempt an edition of the Letters for English-speaking students which should apply the gains of half a century to the elucidation of the many problems still awaiting solution.

In his preface, Prof. Mercer assures us that "wherever new light has been thrown upon unsolved problems, it has been recorded in full", and offers his edition of the Letters "to all students of the Tell el-Amarna tablets, and of the general field which they represent, as an attempt at the last word to date on the subject", adding the qualification that it is merely tentative, "a stepping-stone to a future and better edition whenever new material and new knowledge shall make that desirable".

The work before us consists of 815 pages containing the text and an English translation on opposite pages, with very brief footnotes. We have then 34 pages of Excursus, consisting of nine short essays dealing with various subjects, two of the essays being from the pen of Prof. Hallock. The book is completed by a glossary of 30 pages and indexes of personal and geographical names, and a map of the Tell el-Amarna world. The type and format are all that could be desired.

It must be said at the outset that many English students will be grateful for the boon of an English translation. But from the scholar's point of view (and Prof. Mercer assumes that those who use his edition are already familiar with Knudtzon) the question is bound to be asked whether Prof. Mercer's translation is an improvement on its predecessor in the many passages where the German pioneer version has been recognized to be at fault. A careful comparison shows that Pro Mercer has followed Knudtzon very closely, eve in his mistakes, and that there are several mis translations which arise from a misunderstandin of the German. But a more seriously misleadin feature of the present translation is the abandonment of all the diacritical marks whereby Knudtzo distinguished between the various degrees o probability in his version, so that we have no offered to us without any indication of uncertaint translations which Knudtzon offered only a doubtful conjectures. Hence the student canno safely use Prof. Mercer's translation without havin Knudtzon continually before him.

Students of the philological problems raised b the Letters will turn to the Excursus section o volume 2 in the hope of learning what advance have been made in this field during the last half-century. They will not even find a page devoted to the linguistic peculiarities of the Letters, and it is stated that the language of these documents is Akkadian, although it is now recognized that not more than twenty letters out of the whole collection can be correctly characterized as Akkadian. Indeed, it may safely be said that the language of the greater part of the letters bears the same relation to Akkadian that the language of the books of Esther or Ecclesiastes bears to classical Hebrew.

Another field in which enormous advances have been made is that of Hittite studies. Here, again, the student who consults Excursus V in the hope of finding the last word on the Hittites and their importance in the political activities of the first half of the second millennium B.C. will be disappointed, for the essay represents the state of knowledge about the Hittites which had been reached a quarter of a century ago, and has not even been brought into line with some of the author's footnotes and references to modern literature on the subject, or with the two excellent essays by Prof. Hallock on the Hurrians and the much-debated problem of the Habiru. One has only to compare the map of the Tell el-Amarna world at the end of volume 2 with the map of the same period given in Goetze's "Hethiter, Churriter und Assyrer" (1936) to appreciate the time-lag in knowledge there revealed.

It is with great regret that the judgment must be recorded that a book so much needed, and on which so much devoted labour has been expended, to say nothing of the gallant and generous support of those friends of learning to whom the book owes its publication, fails to meet the tests which modern scholarship will apply to it. None the less, the labours of the author and the loyalty of his friends call for some expression of admiration and gratitude.

S. H. HOOKE.

HISTORY AND SCIENCE

Historian and Scientist

An Essay on the Nature of History and the Social Sciences. By Gaetano Salvemini. Pp. ix+203. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 9*s*. 6*d*. net.

PROF. SALVEMINI has been very well known in Great Britain for more than ten years. He was arrested as an opponent of the Fascist system in 1925, and in the next year was dismissed from his professorship in Florence and had to leave Italy, all his property being confiscated. He has spent the greater part of the time since in Great Britain, made many friends and inspired many with a mind both broad in its grasp and subtle in its distinctions. Latterly, he has been lecturing in the United States, and the book before us consists of interesting reflections on the relations of history and physical science by one who pretends to no special knowledge of the latter but sees clearly that there is an intimate connexion between the two. He rejects early in the book the claim put forward by Cicero that history is not only the *lumen veritatis*, the light of truth, but also the *magistra vitæ*, the teacher of life. This claim cannot be admitted, because the historian and the social scientist have to solve problems of facts and laws like the physicist but not pronounce upon their value. Ethics stands on a pedestal above, and Prof. Salvemini would therefore separate himself from Lord Acton, to whom the moral goodness or badness of his subjects was the supreme object of study.

But if Salvemini limits the scope of history on this side, he widens it immeasurably on another. Directly or indirectly, all historical research aims at solving the basic problem of knowing how the present situation has come to be as it is. This aim clearly covers the state of the physical as of the human world. The whole universe as known to us has been developing from some earlier state, going back to incalculable or infinite ages; the methods used in discovering how it has changed must be similar, though not identical.

Prof. Salvemini is explicit on this point. He tells us that the laws of social life—which includes history—cannot be determined except by the method followed during the past three centuries by the sciences of the physical world—that is, by examining the greatest possible number of facts. The method is the same but the material is different. In each case the facts begin to acquire significance when they are grouped in a system of cause and effect. So far, history and science are alike. They both aim at constructing a system by which the sequence, as we know it, followed by a certain law from what has gone before.

Unfortunately, the remains of the past have very rarely come down to us in a perfect or even reliable condition. This makes the great gulf between the results of the scientist and those of the historian. While the biologist is studying an organ or the chemist analysing a substance or the astronomer observing a star, the historian has to restore the remains which he examines to their original form and detect frequent forgeries and the variations of the different observers who may be faithfully attempting to record what is going on around them. We know in all ages—even in our own of exact wireless reproduction—how widely the impression will differ of any given event which is being recorded. There must be an absolute truth, but it would seem to be beyond the reach of the human mind as it is now constituted to attain it. To take the latest different version of the same event—how much agreement should we find between that of the secretary of Mr. Chamberlain at Munich and that inspired by Herr Hitler or his companions?

We come then to three main results from Prof. Salvemini's survey:

(1) The universe contains an infinite number of objects and events, constantly changing; the neutron is one and the brain-cell another. All may be part of a universal life so far as we are aware. All are material for the study of the scientist and the historian. They are alike in their method of studying the facts, comparing them and attempting to draw some line of filiation from one state or moment to another. This was the method of science developed some three centuries ago and Salvemini would have it applied both to what we call 'organic' and 'inorganic'. So far we must class him with the positive school of thinkers.

(2) The immense difference arises when we consider the simplicity and apparent immobility of the inanimate and the incessant and baffling movement of the living. We do not take this as a final fact, but note it as the present supreme difficulty between the work of the physical scientist and the historian or student of human affairs. For the moment it makes their results incomparably different. We can direct our Blenheim bombers with the utmost accuracy to

the desired spot; we have but the most generalized idea of what is meant when there is talk of an attack on a certain country, nor can we predict the result if such an attack took place.

(3) The parallel inquiries of the scientist and the historian or sociologist are constantly advancing and constantly finding points of contact between the non-living and the living. We are often, it would seem, on the threshold of discovering the point at which the inanimate became the living. It has not yet been found, but an infinity of time remains to breach the gulf and achieve the unity which the word 'universe' implies.

F. S. MARVIN.

HAMILTON'S DYNAMICS

The Mathematical Papers of Sir William Rowan Hamilton

Vol. 2: Dynamics. Edited for the Royal Irish Academy by Prof. A. W. Conway and Dr. A. J. McConnell. (Cunningham Memoir No. 14.) Pp. xvi+656. (Cambridge: At the University Press, 1940.) 70*s.* net.

THIS is the second of the projected four volumes of the mathematical papers of Sir William Rowan Hamilton. The first volume, published in 1931, contained papers on geometrical optics, and the present volume is mainly devoted to dynamics, but includes also some papers on Hamilton's calculus of principal relations, which, as the editors state in the preface, is a natural and obvious extension of his method of the principal function. These volumes differ from most collections of the papers of a mathematician in the very large proportion of hitherto unpublished matter which they contain. Thus in the volume under review we find that the papers here reprinted comprise the two important papers on "General Method in Dynamics" from the *Transactions of the Royal Society*, of 1834–35, and in addition only thirty-five pages of British Association Reports on Hamilton's work and brief notes on such subjects as the dynamics of light, the composition of forces and the hodograph, while the matter now printed for the first time, a hundred years after it was written, runs to more than 460 pages. With a few minor exceptions the whole of the work was written between 1833 and 1839, the characteristic function having first been introduced in the paper on "Theory of Systems of Rays" published in 1827. The editors have told us that the Library at Trinity College, Dublin, contains more than two hundred volumes of Hamilton's notebooks in addition to unbound manuscripts. The selection of what is most suitable for publication and the editing of the papers can be no easy task, and we can only express our admiration for the skill with which the great work is being accomplished.

As in volume 1, the editors remind us that "Hamilton arrived at his conclusions by heavy and laborious preliminary work and by the working of many examples often reached the general results gradually through the particular. When he finally published his results, they appeared in very compact and condensed form, which made his published papers somewhat difficult reading and gave little indication of the labour by which he arrived at the end of his journey". This fact is illustrated by the opening paper of this volume, entitled "Problem of Three Bodies by My Characteristic Function", dated 1833, not hitherto published and preceding by a year the publication of the first of the two papers on "General Method in Dynamics" which follow in this book. The paper contains some interesting results, such as the characteristic function for two bodies, and we see how, by considering the special case of elliptic motion, Hamilton discovered the formula $\delta V/\delta h = t$. But to an average mathematical reader, who would welcome some light on the two following papers, this formidable article of 100 quarto pages with its 1,289 numbered equations may appear a rather forbidding proposition.

To revert to the general arrangement of the book, it consists of three parts. Part 1, "Dynamics of Material Bodies", is concerned almost entirely with the characteristic and principal functions and their applications, and contains a lengthy correspondence with J. W. Lubbock on the application of Hamilton's methods to lunar theory. It also shows us Hamilton inventing the hodograph, though in this Möbius had anticipated him, and Hamilton inventing a proof that the resultant of two rectangular forces is directed along the diagonal of the rectangle.

Part 2, "Calculus of Principal Relations". With the exception of a brief summary in the form of a report to the British Association (1836), this part of the book consists entirely of work not previously published. It is an extension of the method of applying the principal function by means of calculus of variations to the solution of total and partial differential equations. The manuscripts are all of date 1836. It was Hamilton's intention to write a book on the subject, and the four papers now published were written with this aim in view; but like the projected text-book, which was to show students how to apply the characteristic function to problems in geometrical optics, it was not completed.

Part 3, "Dynamics of Light". This part consists of long papers on the propagation of light in crystals, researches respecting vibration connected with the theory of light, and propagation of motion in elastic medium – discrete molecules, all hitherto unpublished, some short notes on researches, and a correspondence on the dynamics of light with Prof. Powell and Sir John Herschel, all of date 1835–39. In one of these papers we find the theory of group-velocity as distinct from phase-velocity, though this theory has often been attributed to Stokes, who set a question on the subject in the Smith's Prize Examination forty years later.

These papers of Hamilton are prefaced by a useful introduction and followed by an editors' appendix, which contains a number of valuable explanatory notes elucidating difficulties in the text and giving references to modern developments. Among these is a short article which quotes Jacobi's criticism of Hamilton's method and explains a method of the editors of obtaining the Hamiltonian form of the principal function S and characteristic function V from Jacobi's complete integral, with several applications.

The first volume was edited by Prof. A. W. Conway and Prof. J. L. Synge. In producing the second volume Prof. Conway has had Prof. A. J. McConnell as his associate, and they are to be congratulated on the production of this further monument to one of the greatest of Irishmen.

A. S. RAMSEY.

THE INTERIOR OF THE EARTH

Physics of the Earth
7: Internal Constitution of the Earth. Edited by Prof. Beno Gutenberg. Contributors: L. H. Adams, Reginald A. Daly, B. Gutenberg, Harold Jeffreys, Walter D. Lambert, James B. Macelwane, *S. J.*, C. F. Richter, C. E. van Orstrand, H. S. Washington. Pp. x+413. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

THE nature of the earth's interior has been a subject of speculation for thousands of years. Ancient philosophers, from the Babylonians onwards, firmly held the belief that the depths were largely occupied by water. Even in the volcanic regions of the Mediterranean, where the subterranean world was naturally associated with ideas of internal fire, this belief was not excluded. Moreover, the winds of the Aeolian Isles were regarded as draughts generated from immense air-filled cavities by the action of the volcanic hearths. These traditional views persisted unchallenged until well into the seventeenth century. In 1695, for example, we find them repeated with characteristic exuberance by John Woodward. But already less fanciful notions were beginning to be formulated. Leibniz in 1680 had clearly expressed the idea of a crystalline crust resting on a molten interior; and a century later (1788) Benjamin Franklin asks: "Can we easily conceive how the strata of the earth could have been so deranged if it had not been a mere shell supported by a heavier fluid?" However, before another century had elapsed, Hopkins and Kelvin had shown that a fluid interior was inconsistent with the phenomena of precession and the tides, and geologists were left to puzzle over Franklin's problem as best they could. With the present century has come the realization that 'non-fluid' or 'solid' does not necessarily imply the crystalline state; vitreous material would fulfil still better the conditions imposed on speculation by the earth's behaviour.

A growing band of geophysicists is now actively engaged in the attempt to solve the dark problems of the earth's interior. The volume under review records progress to date in a series of chapters written by some of the leaders in this field of research. The work is a collective one and certain differences of opinion and interpretation still remain among some of the collaborators. This is not unnatural, since the various lines of evidence do not always lead to unique conclusions. The hypothetical identification of sub-crustal material with dunite (olivine-rock) is a case in point. Here the evidence is that the sub-crustal velocities of earthquake waves correspond roughly with those calculated from the density and elastic constants of dunite under high pressure. But to identify the material with dunite is probably just as wrong as to assume that a substance with the refractive index of water is necessarily water. In the latter case the substance might be cryolite. Geologists will notice with relief that in the present volume the 'dunite' hypothesis is no longer specially favoured.

In his editorial introduction Gutenberg is careful to point out one fertile source of confusion: the fact that the transition from solid to fluid need not be connected, as it has been popularly supposed to be, with the transition from crystalline to non-crystalline. Non-crystalline material, even above the melting point, may be a vitreous solid with high rigidity and viscosity. The problem of the distribution of crystalline and vitreous material in the solid part of the earth is not yet wholly solved.

Jeffreys provides an admirably lucid chapter on the origin of the solar system. He concludes with a succinct statement of the contribution of cosmogony to geophysics: "The earth was once liquid. In this state its free iron and materials soluble in it settled to the center, leaving the silicate shell outside. Since then the shell has become solid, but the core remains liquid to this day."

Daly reviews the approach from geology. He shows that the phenomena of isostasy and the lateral shortening of orogenic belts imply a weak asthenosphere. From the fact that enormous masses of basalt have flooded the surface he infers the existence of a world-circling sub-crustal layer of basaltic composition which, he thinks, at least in the lower part, is in the vitreous state. The trouble about the latter conception is the attendant probability that basaltic eruptions, once started, would fail to stop until the whole of the vitreous part had been expelled. This difficulty would not arise if the vitreous material were of ultrabasic composition. Overlying crystalline basaltic material would then be eruptible only when and where it became locally liquefied, as it might be by the action of sub-crustal convection currents. Daly considers that in Pre-Cambrian times the lithosphere was specially thin and that it was then invaded by magmas on a scale never since equalled; he goes on to correlate these conditions with the probability that the radioactivity of the rocks was then considerably greater than at present. This raises many interesting problems, but they can only be discussed speculatively while we remain in doubt as to the origin of the continents and the reasons for their lateral limitations. Beyond a vague suggestion that the moon may be in some way connected with the absence of continental layers from the sub-Pacific crust, this fundamental question is barely referred to in the present volume.

Besides the introduction and a final summing-up, Gutenberg contributes five other chapters, dealing with the cooling of the earth, forces in the earth's crust, hypotheses on the development of the crust, and the elastic constants, viscosity, strength and internal friction in the interior; in collaboration with Richter he also reviews the evidence from deep-focus earthquakes and summarizes our knowledge of the crustal structure of continents and ocean floors. As there is still no general agreement as to whether or not more heat is produced inside the earth than escapes from it, it is not possible to estimate the importance of thermal contraction in the tectonic history of the earth. Gutenberg thinks that sub-crustal currents, controlled mainly by radio-thermal processes, seem to play the most important part. He refers to seismic evidence suggesting that the transition from crystalline crust to vitreous substratum takes place at a depth of about 60–80 km. The viscosity of the substratum is not too high to prevent convection currents. Those interested in the recent development of the convection current hypothesis should refer to an illuminating paper by Griggs (*Amer. J. Sci.*, Sept. 1939), which appeared too late to be noticed in the present volume.

The elastic properties of crustal materials are reviewed by Adams and the seismic evidence on earth structures by Macelwane. Lambert writes on density, gravity, pressure and ellipticity in the interior. These chapters contain valuable tables of data not easily accessible elsewhere, as indeed does the book as a whole. The observed temperatures in the earth's crust are recorded and discussed by van Orstrand. Readers who are specially interested in this topic will appreciate two relevant papers on heat flow in Great Britain and South Africa that have recently appeared (*Proc. Roy. Soc.*, A, pp. 428–450 and 474–502; 1939). Geochemical aspects of the earth's constitution are discussed by Washington in a posthumous chapter prepared several years ago, but recently revised by Adams. It contains an interesting account of meteorites and tectites and also a brief section on terrestrial magnetism. The absence of a chapter dealing more systematically with the latter subject is probably to be ascribed to the fact that Vol. 8 of this series on the "Physics of the Earth" is devoted to terrestrial magnetism and electricity (see NATURE, Jan. 13, 1940, p. 47).

Finally, mention should be made of the very full bibliographies. Each chapter—except the final summary—has its own, and altogether there are 852 references, more than a quarter of which are to seismic evidence and its application to the exploration of crust, substratum and core. Prof. Gutenberg and his committee are to be congratulated on the production of a well-written, authoritative and most welcome book which will be highly and deservedly appreciated by a very wide circle of readers in many branches of science.

ARTHUR HOLMES.

CONSERVATION AS A FOUNDATION OF PERMANENT PEACE*

By The Hon. Gifford Pinchot,

Former Governor of the State of Pennsylvania

THIRTY-TWO years ago there was held in Washington a Conference which was the first of its kind. It was the first not only in America but also in the world. It was also the first conference in the history of this country of the Governors of all the States and Territories with the President of the United States. Since it included also the Congress, the Cabinet, the Supreme Court, scientific experts, representatives of national associations, and outstanding citizens, it was one of the most distinguished gatherings ever brought together in the United States.

But no one of these was the essential reason for its epoch-making importance. The reason why the meeting of the Governors with President Theodore Roosevelt in the White House in May, 1908, may well be regarded by future historians as a turning point in human history, the reason why it exerted and continues to exert a vital influence on the United States, on the other nations of the Americas, and on the nations of the whole world, is this: it was called to introduce, and it did introduce, to mankind the newly formulated policy of the conservation of natural resources.

Even at that time the profound significance of conservation was beginning to make itself felt. In announcing his intention of calling the Conference, the President said: "The conservation of natural resources is the fundamental problem. Unless we solve that problem it will avail us little to solve all others. . . . It [the Conference] ought to be among the most important gatherings in our history, for none has had a more vital question to consider."

This Conference set forth in impressive fashion, and it was the first national meeting in any country to set forth, the idea that the protection, preservation, and wise use of the natural resources of the earth is not a series of separate and independent tasks but one single problem. As the President said: "The various uses of our natural resources are so closely connected that they should be co-ordinated, and should be treated as parts of one coherent plan."

The Conference asserted that the conservation of natural resources is the one most fundamentally important problem of all. It drove home the basic truth that the planned and orderly development of the earth and all it contains is absolutely indispensable to the permanent prosperity of the human race. It spread far and wide the new proposition that the purpose of the conservation of natural resources is the greatest good of the greatest number for the longest time. It taught the people of the United States, and other peoples, the new meaning of the word conservation, which in its present application to natural resources was then generally unknown.

By defining, describing, and making known the new word and the new policy, by endowing it with the approval and support of the leaders of all the States, of the great industries, and of the nation itself, the Governor's Conference put conservation in a firm place in the knowledge and the thoughts of the people. From that moment conservation became an inseparable part of the national policy of the United States.

It is worth mention that this brilliant example of national foresight occurred not in a time of scarcity, not in a depression, but in a time of general abundance and well-being. The unanimous declaration of the Governors ended with this discerning admonition: "Let us conserve the foundations of our prosperity."

It may be difficult to-day, when conservation is accepted almost as widely as the Ten Commandments, to realize that only a generation ago there was no such thing as a conservation policy. The very word conservation, as we use it to-day, had no existence.

The conception which we know as conservation originated and was formulated in the United States Forest Service in the early winter of 1907. Conservation grew out of forestry. Thus, conservation was born without a name. But it had to be given a name before it could be introduced to the people.

After discussion among perhaps half a dozen men, the name conservation was tentatively decided on. Thereupon it was submitted to and approved by Theodore Roosevelt, and the infant was christened accordingly. We know the growing youngster, thirty-three years old but growing still, by that same name to-day. The hold conservation has gained in these thirty-three years upon the civilized peoples of the world is little less than amazing. To-day the soundness of the conservation policy is everywhere accepted as a matter of course.

---

*Substance of a paper read on May 11 before the Eighth American Scientific Congress at Washington.

The Conference of Governors recommended and was followed by the appointment of conservation commissions by a majority of the States, and of the National Conservation Commission, which latter in January of 1909 submitted to the President the first national inventory of natural resources ever made. In February of the same year the North American Conservation Conference, the first international conference to consider the policy of conservation, met in Washington at the invitation of President Theodore Roosevelt.

In his address at the opening of the Conference in the White House the President made this highly significant statement:

"... In international relations the great feature of the growth of the last century has been the gradual recognition of the fact that instead of its being normally to the interest of one nation to see another depressed, it is normally to the interest of each nation to see the others elevated. . . . I believe that the movement that you this day initiate is one of the utmost importance to this hemisphere and may become of the utmost importance to the world at large."

The North American Conservation Conference declared that the movement for the conservation of natural resources on the continent of North America "is of such a nature and of such general importance that it should become world-wide in its scope". Therefore it suggested to the President "that all nations should be invited to join together in conference on the subject of world resources and their inventory, conservation, and wise utilization".

What the Conference thus recommended was, however, already under way. The President had foreseen that the North American Conference would be the precursor of a world conference. Accordingly, to quote Elihu Root, then Secretary of State: "By an aide-memoire in January last [1909], the principal governments were informally sounded to ascertain whether they would look with favour upon an invitation to send delegates to such a conference. The responses have so far been uniformly favourable, and the conference of Washington has suggested to the President that a similar general conference be called by him. The President feels, therefore, that it is timely to initiate the suggested world conference for the conservation of natural resources, by a formal invitation."

With the concurrence of the Netherlands, invitations were sent to fifty-eight nations to meet at the Peace Palace in The Hague in September, 1909. Thirty of the nations, including Great Britain, France, Germany, Canada, and Mexico, had already accepted when President Taft, who succeeded Theodore Roosevelt on March 4, 1909, killed the plan.

Two attempts have been made to revive it. At the end of the War of 1914-18, President Wilson, at the suggestion of Colonel House, took steps toward securing world-wide co-operation in the conservation and distribution of natural resources. Unfortunately nothing came of it.

During President Hoover's administration a group of nearly two hundred leading citizens from all parts of the United States urged him in a public petition to take action along the same general line. Again nothing came of it.

But these checks notwithstanding, the conservation problem remains the fundamental human problem. Without natural resources, no human life is possible. Without abundant natural resources civilized life can neither be developed nor maintained. To the human race, land is the basic natural resource. The demand for new territory, made by one nation against another, is a demand for additional natural resources; and it is not necessary to point out how many times this demand has plunged nations into war.

In view of the foregoing, I have a definite plan to suggest—a plan for permanent peace through international co-operation in the conservation and distribution of natural resources.

National life everywhere is built on the foundation of natural resources. Throughout human history the exhaustion of these resources and the need for new supplies have been among the greatest causes of war.

A just and permanent world peace is vital to the best interests of all nations. When the terms which will end the present War are considered, the neutral nations should be in position to assist in finding the way to such a peace. That being so, it would be wise to prepare in time.

The proposal is that the nations of the Americas prepare now for an endeavour to bring all nations together, at the right moment, in a common effort for conserving the natural resources of the earth, and for assuring to each nation access to the raw materials it needs, without recourse to war.

In all countries some natural resources are being depleted or destroyed. Needless waste or destruction of necessary resources anywhere threatens, or will threaten, sooner or later, the welfare and security of peoples everywhere. Conservation is clearly a world necessity, not only for enduring prosperity but also for permanent peace.

No nation is self-sufficient in essential raw materials. The welfare of every nation depends on access to natural resources which it lacks. Fair access to natural resources from other nations is therefore an indispensable condition of permanent peace.

War is still an instrument of national policy for the safeguarding of natural resources or for securing them from other nations. Hence international co-operation in conserving, utilizing, and distributing natural resources to the mutual advantage of all nations might well remove one of the most dangerous of all obstacles to a just and permanent world peace.

The conservation of natural resources and fair access to needed raw materials are steps toward the common good to which all nations must in principle agree. Since the American nations are less dependent on imported natural resources than European nations, and since they are already engaged in broadening international trade through negotiated agreements, their initiative to such ends would be natural and appropriate.

The problem of permanent peace includes, of course, great factors which the foregoing proposal does not cover. But it does cover that factor which is certainly, in the long run, the most potent of them all.

If the foregoing proposal is adopted, facts in support of it will be needed, and a plan for assembling them. The formulation of a general policy and a specific programme of action would follow.

Facts for each nation separately, for groups of nations, and for the whole world might well be assembled under the general classes of forests, waters, lands, minerals, and wild-life. In very brief outline they should include: resources in existence; consumption; probable duration; waste; conservation, if any; necessary reserves; available surplus; present interdependence of nations in natural resources (raw materials), with the origin, destination, and quantities of imports and exports; present barriers to 'fair access'; and sources of pressure upon nations to acquire natural resources.

The information just outlined undoubtedly exists in sufficient detail for the present purpose, and can be put together without original investigation. It could well be done through a Commission appointed for that purpose representing all the American nations.

The gathering of information through the creation of such a Commission might, I believe, properly be recommended by the Eighth American Scientific Congress to the Governments of the American nations.

Formulation by the Commission of a plan and of recommendations to the American Governments for a general policy and a specific programme of action, including the presentation of the plan when prepared to neutral and belligerent nations, would follow.

Such a Commission would be of immense and lasting value to the American nations. It could not but advance their interests, both individual and mutual, in addition to opening a road toward a workable basis for permanent peace.

Finally, the situation in Europe and in Asia suggests that action for the purpose outlined above was never more necessary than at present.

THE UTILIZATION OF PETROLEUM GASES*

By Dr. A. E. Dunstan,

ANGLO-IRANIAN OIL COMPANY, LTD.

IT is interesting at the outset to realize the quantities involved in the problem of the utilization of natural gas. In 1938 there was a production of about 270 million tons of crude oil. Superimposed on the oil and in solution there is natural gas, and that gas production is estimated at an almost astronomical figure which may be compared with the ordinary coal gas production in the United Kingdom.

World production of petroleum 1937	276,000,000 tons
„ „ „ „ 1938	268,000,000 „
Annual world production of natural gas (approx.)	3,000,000,000,000 cu. ft
Annual world production of gas from cracking process	300,000,000,000 „
Coal gas produced in the United Kingdom in 1937	550,000,000,000 „

An oilfield has the following geological structure: an anticline, an impervious cap rock, gas dome and below that an oil-bearing structure, and farther down a water horizon the pressure of which forces the oil up into the drilled well. It is clear that a well drilled, for example, into the uppermost gas horizon will miss the oil and will lead to the diminution of gas pressure. It is, therefore, the business of the geologist and the geophysicist to indicate to the production engineers where to locate their wells.

The oil and gas coming up from the well pass into a separator, which may be upwards of 150 ft. in length; this takes off the high-pressure gas, up to two to three thousand lb. pressure, from the crude oil. Hence there remains a solution of gas in oil, together with free gas, mainly methane, coming off from it. The methane is thus separated, but obviously the oil itself must contain dissolved gas. There follows, therefore, a series of multi-stage

* Based on a Friday evening discourse at the Royal Institution.

separators in which the ethane, propane and butane can be removed from their solution in the oil. The various dissolved gases are thus released stage by stage. This low-pressure gas, which inevitably carries with it a certain quantity of low-boiling liquid hydrocarbon material, has now to be handled. The gas is passed up lofty towers counter-current to a stream of solvent oil passing downward. This dissolves all the volatile liquid matter that can ultimately be put into motor spirit; in effect, it is the removal of the last traces of liquefiable hydrocarbons from what might be called the true gases. There is a further stage; the volatile material thus recovered by distillation from the solvent contains material of low boiling point, and it is necessary in order to make the recovered volatile spirit into motor fuel, to remove from it material of specially low boiling point which seriously affects volatility of the finished petrol and would cause vapour lock in a motor-car engine.

The gases thus obtained from the crude oil are methane, ethane, propane and the butanes. They belong to the class of saturated hydrocarbons called paraffins. Etymologically the word 'paraffin' is, of course, entirely wrong. The word 'paraffin' implies something without any reactivity, with 'no affinity', whereas these gases have a great deal of reactivity. A special application of the dry gas, mainly methane, lies in its partial combustion to carbon black. The gas is burned against a revolving cooled surface and deposits what is in effect a very fine soot. This is scraped off, and finds a considerable outlet as a component with rubber of motor tyres. Further, when incorporated with oil, it yields printer's ink. There is also a rapidly expanding market for liquefied propane and butane —'bottled gas'—as a convenient domestic and industrial fuel. In point of fact, 150,000,000 gallons were sold in the United States in 1938. Notwithstanding that the dry gas is essentially paraffinic, in certain crudes—very limited in number—occurs the rare element helium, isolated by intense cooling and used as a lifting medium in airships by virtue of its low density. Finally, mention should be made of the occurrence of carbon dioxide and hydrogen sulphide in certain cases.

By the impact of high temperature the paraffin gases can be decomposed, in the first place to olefines by simple dehydrogenation and then to a complex mixture containing, in the main, aromatic hydrocarbons. For example, when methane is treated at a temperature of about 1050° C., benzene, toluene, xylene and styrene are obtained, together with naphthalene and anthracene. In effect, a sort of coal tar is produced in so far as the high-boiling components are concerned.

But it must be realized that methane is the most recalcitrant of the paraffins, and to-day pyrolysis is practised on material which is more reactant, for example, butane and propane, not only for the production of aromatic hydrocarbons but also for the preparation of olefines. Further, there are vast amounts of gases produced by what is called the 'cracking' process, that is, the production of light hydrocarbons from heavier oil. This gas is made up of olefines (ethylene, propylene, and the butenes, associated with the corresponding paraffins), and these are much more important starting materials for synthesis than straight natural gas.

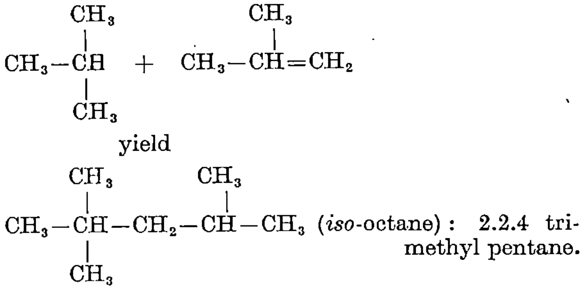
Cracking is a thermal decomposition; oil is converted by heat into material lighter, and into material heavier—into gas, motor-spirit and into heavy residue. The impetus to cracking actually began with the necessity of making more motor-spirit per gallon of crude oil. It was a quantity production.

Cracking was first carried out to get more motor fuel. Times have changed, and to-day the concern of the industry is to get material of higher octane value, which gives better performance in the engine. In other words, quantity is sacrificed to quality. The tendency to-day is to get higher and higher thermal efficiency, and higher and higher octane values. Most straight motor fuels are heavily cracked to get this higher performance. By such intensive cracking—known as the 'reforming' operation, about 30 per cent of the spirit comes away in the form of gas. When that gas is submitted to fractionation to separate heavier material from lighter, a cut of the C_3 and C_4 fractions is obtained; this is a potential source of high octane motor fuel and other synthetic derivatives. Hence the problem of making full use of the olefines, either straight olefines from the cracking operation, or olefines produced by the dehydrogenation of the paraffins present in the gases from the well must be considered; and so a series of operations arises concerned with the utilization of these derived unsaturated hydrocarbons.

This production of gaseous and liquid material by thermal decomposition or cracking is an example of Faraday's pioneering spirit. Faraday took the product of the cracking of fatty oils and obtained a series of fractions from the product, among which is one that boils at 180° F. Faraday put the samples thus obtained into a mixture of ice and salt, and obtained from one a crystalline material which he purified by squeezing away the accompanying oily matter, and this was benzene.

It has already been stated that the term 'paraffins' is a misnomer. For example, when *iso*-butane is brought into contact with *iso*-butene or its dimer in the presence of sulphuric acid as a catalyst, a remarkable combination takes place, for the tertiary atom of the *iso*-butane comes into reaction, and the result is a saturated hydrocarbon of a very high value in the internal combustion engine.

CATALYTIC ADDITION OF ISOBUTANE TO ISOBUTENE



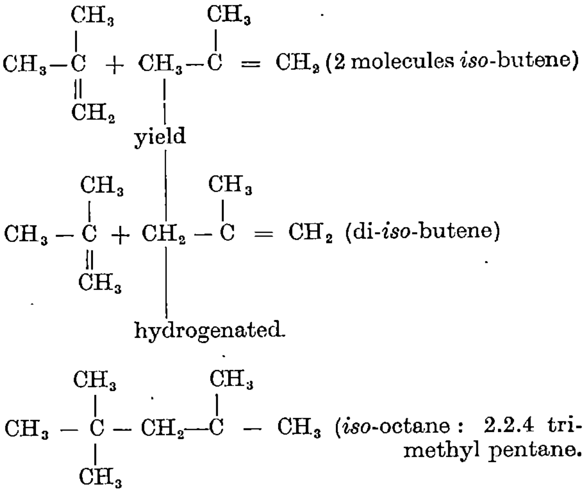
$$\begin{array}{l} \quad CH_3 \qquad\qquad\quad CH_3 \\ \quad | \qquad\qquad\qquad\quad | \\ CH_3-CH \quad + \quad CH_3-CH=CH_2 \\ \quad | \\ \quad CH_3 \\ \qquad\quad \text{yield} \\ \quad CH_3 \qquad\quad CH_3 \\ \quad | \qquad\qquad\quad | \\ CH_3-CH-CH_2-CH-CH_3 \ (\textit{iso}\text{-octane}):\ 2.2.4\ \text{trimethyl pentane.} \\ \quad | \\ \quad CH_3 \end{array}$$

It has long been known that the addition of an olefine to the aromatic hydrocarbon benzene can be achieved by the use of such a catalyst as aluminium chloride, but the simple addition of an olefine to a paraffin containing a tertiary carbon atom, using ordinary strong sulphuric acid as a contact medium, is new, and will have the most far-reaching effects on the petroleum industry.

Consider the potentialities. In the cracking process vast amounts are made of unsaturated hydrocarbons containing C_3 and C_4 derivatives. The natural gas of petroleum contains also great volumes of *iso*-butane. Also, it is quite certain that the even greater amounts of *n*-butane can be isomerized to *iso*-butane. The product of this addition reaction is in the main a C_8 paraffin of specially high 'octane value', that is, it has the capacity of notably withstanding detonation in the internal combustion engine. Of course there are also supplementary reactions, but careful distillation analysis indicates clearly various sharp fractions, mainly, in point of fact, isomeric octanes.

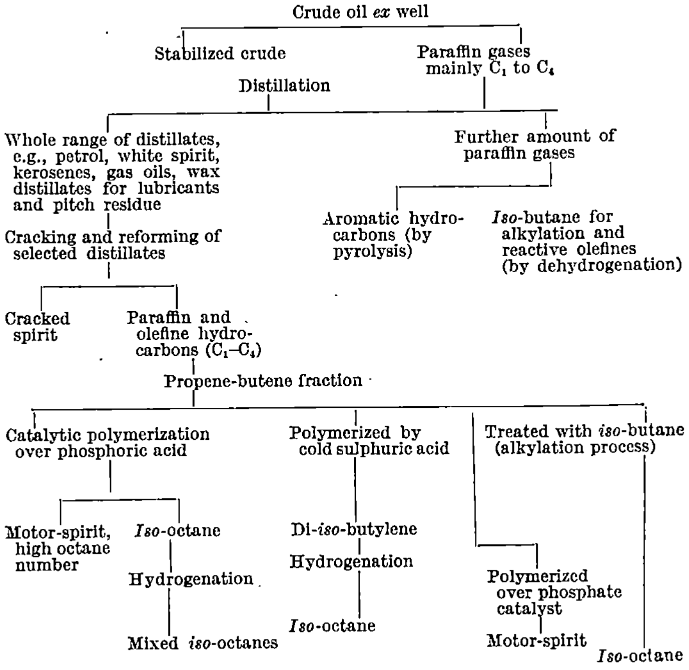
Furthermore, the polymerization of cracked gases is readily effected ; for example, ethylene (C_2H_4) can by the simple impact of pressure, temperature and time be converted into liquid fuel of the motor-spirit type. But a more effective way of converting C_3 and C_4 olefines into motor-spirit is by polymerization in the presence of a catalyst, and in particular one based on phosphoric acid. As a case in point, there has been used, with considerable success, copper cadmium phosphate. Such polymerization yields a motor-spirit of good quality, but if a selected cut or fraction of the total product is separated and submitted to hydrogenation, then again a C_8 mixed *iso*-octane is produced, just as it was in the case of the addition of butene to *iso*-butane. Further, if *iso*-butene also present in the C_4 cut from cracked gas is treated with cold sulphuric acid, it passes via tertiary butyl alcohol on warming to di-*iso*-butene (C_8H_{16}). This again, on being hydrogenated, yields *iso*-octane. So polymerization helps materially to increase the volume of high-octane gasoline.

DIMERIZATION OF ISO-BUTENE



$$\begin{array}{l} \quad CH_3 \qquad\qquad\quad CH_3 \\ \quad | \qquad\qquad\qquad\quad | \\ CH_3-C \quad + \quad CH_3-C \ = \ CH_2\ (2\ \text{molecules}\ \textit{iso}\text{-butene}) \\ \quad \| \qquad\qquad | \\ \quad CH_2 \qquad\quad | \\ \qquad\qquad\quad \text{yield} \\ \quad CH_3 \qquad\qquad\quad CH_3 \\ \quad | \qquad\qquad\qquad\quad | \\ CH_3-C \quad + \quad CH_2-C \ = \ CH_2\ (\text{di-}\textit{iso}\text{-butene}) \\ \quad \| \\ \quad CH_3 \\ \qquad\qquad\quad \text{hydrogenated.} \\ \quad CH_3 \qquad\qquad\quad CH_3 \\ \quad | \qquad\qquad\qquad\quad | \\ CH_3-C-CH_2-C-CH_3\ (\textit{iso}\text{-octane}:\ 2.2.4\ \text{trimethyl pentane.} \\ \quad | \\ \quad CH_3 \end{array}$$

Summing up then, a simple chart will illustrate how these various processes are effective in utilizing hitherto waste gases.


Crude oil *ex* well
Stabilized crude
Paraffin gases mainly C_1 to C_4
Distillation
Whole range of distillates, e.g., petrol, white spirit, kerosenes, gas oils, wax distillates for lubricants and pitch residue
Further amount of paraffin gases
Aromatic hydrocarbons (by pyrolysis)
Iso-butane for alkylation and reactive olefines (by dehydrogenation)
Cracking and reforming of selected distillates
Cracked spirit
Paraffin and olefine hydrocarbons (C_1–C_4)
Propene-butene fraction
Catalytic polymerization over phosphoric acid
Polymerized by cold sulphuric acid
Treated with *iso*-butane (alkylation process)
Motor-spirit, high octane number
Iso-octane
Hydrogenation
Mixed *iso*-octanes
Di-*iso*-butylene
Hydrogenation
Iso-octane
Polymerized over phosphate catalyst
Motor-spirit
Iso-octane

In so brief a résumé of the chemistry of these gases it is impossible to do justice to the development of a new synthetic chemistry based on the lower hydrocarbons. It is clear that it is possible to look forward to the time when the petroleum industry will furnish the starting-out materials for a whole range of products so diverse as ethylene glycol—the familiar anti-freeze in the motor-car; sulphur from the crude gases at the oilfields; synthetic motor fuel prepared from methane oxidized into a liquid fuel; the isomerization of normal paraffins; explosives such as T.N.T. (actually in fact produced in 1916); synthetic rubber, which is got by intensive polymerization of ethylene; high polymers of value in increasing the viscosity of lubricants; a whole range of derivatives of the aromatic hydrocarbons obtained by pyrolysis or by the cyclization and aromatization of straight chain paraffins—resins and plastics from the polymerization products of olefines such as *iso*-butene; acetylene by the dehydrogenation of methane; ether and ketones as solvents and high anti-knock fuel; alcohols, esters and a whole range of solvents through the halogen derivatives of paraffins; and the very striking synthesis of glycerol from propylene. The vast synthetic chemical industry based on coal tar is familiar to all. The new industry, based on petroleum, is certain to outstrip it in the magnitude of its operation and the variety of its products.

FORMS OF SOCIETY AND EUROPEAN RULE IN AFRICA

FOR some time now it has been evident that a more intensive study of the political institutions and systems of native Africa was an increasingly urgent necessity. New and more searching methods of investigation have brought out the weaknesses and misconceptions of the older material, while of the more recent accounts of African economy complying with the standards of modern research, the extent is inadequate for the requirements of comparative study on the lines laid down in the development of sociological theory as applied in the study of the simpler societies. In such studies African political institutions will ultimately assume a place of importance, for they range from forms which ally themselves to those regarded as among the more primitive in the constitution of human societies, to those which in their extent and organization have been pronounced worthy to rank as great kingdoms and even empires, though of barbaric type, such as the West African emirates. In these, as well as in the details of the adjustment of social forces in the less advanced societies, there is abundant evidence of the political genius of Africa, which is not without its lessons for the study of more advanced communities.

Apart from the requirements of scientific and comparative study, there is a practical reason why more detailed and intensive investigation should be undertaken. The adoption of Indirect Rule throughout the greater part of British Africa, and the possibility that other Colonial powers, in that co-operation in native administration to which we are pledged, may wish to assimilate their methods in some degree to those of British administration, render it imperative that the application of the principle of utilizing and adapting native institutions to the requirements of European control should be based upon precise knowledge of the nature of those institutions, and even more important, of the consequences and implications of any changes or adaptations in the native social and political relations inevitable under the impact of European control. This is all the more important as the effects of social disharmony extend their ramifications beyond the machinery for the preservation of law and order to provinces of amelioration and reform affecting the land, its utilization and preservation in good heart, hygiene, the well-being and education of the individual, his employment, the health of his stock and the like.

While the anthropologist in dealing with political and social institutions is concerned solely with scientific and objective study of the facts, it is inevitable that maladjustments and misunderstandings which arise out of European contacts and control should come under his notice. From these maladjustments even Indirect Rule is not exempt. It is, in fact, well known that both misunderstanding and friction have arisen from insufficient grounding in knowledge of the facts in certain situations, no preliminary or an insufficiently intensive survey having preceded introduction of this system of rule, or administrative co-operation. Too great reliance has been placed upon an assumed universality of the authority of the chief in African society; and this has been allowed to warp judgment in assessing the bearing of facts not always perfectly understood. Comparatively unimportant individuals have been given official status, while the real seat of tribal authority, sometimes with native connivance, functions undiscerned behind a veil. In the result, what emerges is not Indirect Rule but a purely British bureaucratic system.

This applies also under the French administrative system, for which its admirers have sometimes claimed that it approaches Indirect Rule without some of its more obvious disadvantages.

Something more than a beginning—indeed a substantial contribution towards the detailed anthropological survey of African societies which should form the basis of future post-War administration in Africa—has been made in a volume issued by the International Institute of African Languages and Cultures under the joint editorship of Dr. E. E. Evans-Pritchard and Dr. M. Fortes*, with a foreword by Prof. A. R. Radcliffe-Brown on the general methods of sociological inquiry as applied to simple societies. Here are given in condensed form the results of field investigations by different observers into the political systems of eight widely distributed African peoples. These studies cover South Africa (Zulu, Ngwato of Bechuanaland, Bemba of North-Eastern Rhodesia), East Africa (Ankole of Uganda, and Bantu Kavirondo), West Africa (Kede, Tallensi), and Sudan (Nuer). Although not completely comprehensive as to type, as the editors point out, the eight societies afford a general picture of the main forms of African political systems.

The eight types of political systems here described fall into two groups. Of these, the first includes those in which the maintenance of law and order and the dispensation of justice are dependent upon a centralized organization culminating in a paramount chief who rules with the assistance of a council and through a number of regionally distributed subordinate chiefs. Such a system, obviously, lends itself to the requirements of European rule. In the second group there is no such centralized organization with a supreme head. The society is organized in accordance with lineage and is 'segmented', each group being autonomous and independent of the others. Law and order are maintained by a nice adjustment of interests at each and every point of contact between groups. In such a system, European control, either through lack of understanding or through administrative requirement—sometimes both—has constituted headmen functioning as do the chiefs of the first group in relations between administration and people.

In estimating the value and effect of Indirect Rule as a mode of administration which has as its object that of introducing the minimum of disturbance into the economy of tribal life through European control, there is a number of important considerations to be taken into account, of which the most important is the fact that the power of the paramount chief is by no means absolute. By an extensive system of check and countercheck—the council, queen's courts, the rights, duties and interests of officials and subordinate chiefs and the like—there is throughout the community a balance of power which not only limits the power of the chief, but also ensures the continuity and preservation of custom, secures the effective representation of every grade of society in the general direction of affairs, and in the ultimate analysis places what would correspond to 'sovereignty' in the hands of the people. It is inevitable that this delicate adjustment should suffer dislocation under European control. Even Indirect Rule cannot avert the disturbance involved in depriving the chief of the power of initiating legislation independently and of making war. In the result, in the societies of the first category mentioned above, the chief has become a buffer between administration and people, who on whichever side his sympathies lie—and usually and naturally they are with his own kin—is suspect to both, or at least his actions subjected to strict supervision on one side, carping criticism on the other, even or most often when officially dictated. No less important is the fact that the religious and symbolic bond centring in the chiefly office, which so often binds together African societies of the centralized type, is weakened beyond repair.

It is inevitable that some measure of friction and disturbance must arise in African societies when under European control; and Indirect Rule, which aims at respecting African institutions, so far would seem to have been the most successful in minimizing its effects. Where we now stand, however, in our relations with other powers ruling in the greater part of Africa, opportunity will be afforded, when other preoccupations are less insistent, to consider what forms of control will best promote the future prosperity of the African. To attain this end there are certain essentials. First, full and free co-operation between all European powers administering African territory, not necessarily to secure uniformity in administrative method, but rather to ensure that such forms of rule as are applied should be most suitable to the character and circumstances of the governed in each instance. Secondly, and following from this, that decision should be made only after close intensive study of the respective native institutions, cultures and modes of thought; and thirdly, since through European contact and control change must come, that that change should be canalized in such direction as sociological and economic research may indicate as likely to enable the African best to bear his part in world economy. The severest stricture on Indirect Rule which its critics are in a position to make is that it lacks direction.

---

* African Political Systems. Edited by Dr. M. Fortes and Dr. E. E. Evans-Pritchard. (Published for the International Institute of African Languages and Cultures.) Pp. xxiii+301. (London: Oxford University Press, 1940.) 15s. net.

OBITUARIES

Dr. R. J. Lythgoe

By the death of Richard James Lythgoe, the subject of special sense physiology has suffered a most severe loss. Dr. Lythgoe was forty-four years of age, and received his education at Mercers' School and Trinity College, Cambridge, the latter phase being interrupted when, at the age of nineteen, he joined the R.G.A., in which he served throughout the War of 1914-18, experiencing heavy and nerve-shaking fighting.

Returning to Great Britain, Lythgoe studied medicine at University College Hospital, and took the Cambridge M.B., Ch.B. in 1924. Almost immediately afterwards he joined the staff of the Department of Physiology at University College, as Sharpey scholar, and held that post for a year. His first paper, published then, in collaboration with another, dealt with the pulse-rate and oxygen-intake during recovery from severe exercise. It was evident, however, that his interests lay in another direction, for in 1926 he was awarded a Beit Memorial research fellowship, and commenced the study of the physiology of the special senses, in which branch he worked for the remainder of his life, and gained international distinction. All his work was carried out at University College, London, and he was a part-time teacher, and later University reader in the physiology of the special senses, in the Department of Physiology, Pharmacology and Biochemistry of the College. He held Beit fellowships and senior Beit fellowships from 1926 until 1933, after which time his researches were in part financed by the Medical Research Council and by the Rockefeller Foundation.

It is no exaggeration to say that Lythgoe was one of a few physiologists in Great Britain who have done signal work for their subject by resuscitating an important branch of it from a state of neglect into which it had fallen during the preceding decades. In some two dozen papers he, with collaborators, covered many important aspects of special sense physiology, many of them of clear practical importance. For example, the work on the measurement of visual acuity, or that on the adaptation of the eye in relation to the critical frequency of flicker, had valuable practical bearings. Other work, particularly that on which he had been engaged just prior to the present War, and which was undertaken jointly with Dr. C. F. Goodeve, dealt with the photochemistry of visual purple, and was of outstanding theoretical importance.

Many advanced students during the past twelve years will remember Dr. Lythgoe's annual public lectures on the physiology of vision, and the practical instructions and demonstrations with which these were supplemented, and in which his flexible versatility in laboratory work was so strikingly illustrated. His wife, Dr. Katharine Tansley, whom he married in 1931, was one of his early pupils at these classes, and a constant collaborator with him in furthering the study of the branch of work in which he had engaged.

Lythgoe was an unexceptionable colleague, loyal, modest and always helpful and dependable; capable of fine and artistic appreciation and a consummate investigator. He could on many occasions have occupied a chair of physiology, but preferred the path of pure research unhampered by administrative duties or by the labour of teaching outside his real interests. When he was persuaded to undertake administrative work, however, he did it with the zeal and thoroughness which characterized all his doings. His work as a joint secretary of the Physiological Society, and as a member of the editorial board of the *Journal of Physiology* are instances of his faithful work. At the time of his death he was engaged on work of national importance.

Dr. Lythgoe died on February 28, and leaves a widow, a son and two daughters, the younger born in January last. To them we extend our very sincere sympathy in their bereavement.

Prof. Felix Plaut (1877-1940)

Prof. Felix Plaut, whose death occurred on June 27 at Epsom, where he had been engaged in research work on the reaction of vitamin C to neurological and psychiatric conditions, was born at Cassel on July 7, 1877. He studied medicine at Geneva and Berlin, and qualified at Munich in 1902. His principal work, which was carried out at the Robert Koch Institute for Infectious Diseases in Berlin and at the Psychiatric Clinic at Munich, where he was appointed to an additional professorship in 1915, was concerned with the study of the nervous system, especially the cerebrospinal fluid, and the serological and psychiatric aspects of syphilis. His chief publications were on the Wassermann reaction in psychiatry (1909), examination of the cerebrospinal fluid (1913), hallucinations in syphilis (1913), general paralysis in negroes and Indians (1926), and the treatment of syphilitic mental disorders. For several years he was one of the editors of the *Zeitschrift für die gesamte Neurologie und Psychiatrie*.

We regret to announce the following deaths:

Mr. J. H. Fleming, formerly president of the American Ornithological Union, honorary curator of the Royal Ontario Museum of Zoology, on June 27, aged sixty-seven.

Prof. W. Frecheville, emeritus professor of mining in the Royal School of Mines, on July 30, aged eighty-six.

Surgeon Rear-Admiral E. L. Pearce Gould, formerly dean of the Middlesex Hospital Medical School, on August 1, aged fifty-four.

Prof. Hans Virchow, professor of anatomy in the University of Berlin.

NEWS AND VIEWS

The Hon. Gifford Pinchot

THE idea of conservation of natural resources is of American origin, having been formulated by the United States Forest Service so recently as 1907. The history of the development of this idea since that date, and attempts to use it as a basis for international unity and amity, is described by the Hon. Gifford Pinchot on p. 183 of this issue. Dr. Pinchot continues with a valuable proposal to utilize and develop even further this idea at the peace which will follow the present conflict. No one is better qualified than Dr. Pinchot to press these proposals, which are very worthy of consideration not only by men of science but also by all who can justifiably claim a hearing when terms of peace are up for consideration. Dr. Pinchot was a forester in the U.S. Department of Agriculture during 1898–1910. He was commissioner of forestry, Pennsylvania, during 1920–22 and governor of that State during 1923–27 and 1931–35. For a long period he held the chair of forestry in Yale University and has served on several National Commissions of Conservation. Among his publications are books on forestry and one entitled "The Fight for Conservation" (1909).

U.S. National Defence Research Committee

IT is announced by Science Service that the following committee has been appointed in the United States to correlate "scientific research on the mechanisms and devices of warfare":

Dr. Vannevar Bush (chairman), president of the Carnegie Institution of Washington, formerly dean of the faculty of engineering at the Massachusetts Institute of Technology;

Prof. Richard C. Tolman (vice-chairman), dean of the graduate school and professor of physical chemistry and mathematical physics at the California Institute of Technology;

Dr. Irvin Stewart (secretary), formerly Federal Commissioner for Communications and chairman of the Committee on Scientific Aids to Learning;

Rear Admiral Harold G. Bowen, director of the Naval Research Laboratory, Anacostia, D.C.;

Conway P. Coe, U.S. Commissioner of Patents;

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, formerly professor of physics at Princeton University;

Dr. James B. Conant, president, formerly professor of organic chemistry, Harvard University;

Dr. Frank B. Jewett, president of the Bell Telephone Laboratories;

Brigadier General G. V. Strong, assistant chief of staff, U.S. Army.

Assessment of Public Opinion

RECENT discussions in Parliament have directed critical attention to the use of 'market research' methods by the Ministry of Information for the purpose of assessing public opinion. The political aspects of the inquiries naturally loomed largest in the debate. It is well to remember, however, that the question is not one solely of the political repercussions of applying a mature scientific procedure. The scientific basis of such work also deserves scrutiny. In at least two important respects the method is scientifically still in its early stages. First, it has not fully explored the possibilities of error which lurk in its basic tool, namely, the question. Secondly, it seldom has any reliable criterion for testing the validity of its results. The work of Muscio (following Stern and Lipmann) demonstrated so long ago as 1916 that the form in which a question is worded has an important effect on the information which it elicits. Muscio showed the importance of points which go far beyond the avoidance of what common sense and legal rulings recognize to be suggestive questions. Unaccountably, Muscio's work has not been carried further by later psychology. Still more unaccountably, no means have been devised of putting his findings to practical account in social inquiries.

Measures of public opinion could be shown to be valid if they made possible the accurate prediction of public action. But this test can seldom be applied. Occasionally the results of elections have been predicted, sometimes with striking success, sometimes with inaccuracies which are traced to the underestimation of an apparently minor factor in the situation. Moreover, public opinion is fluid, a continuous activity rather than a state; and therefore a snapshot which is accurate at a given moment may not have predictive value for public action even a short time later. The importance of this factor will depend partly upon the extent to which the topic investigated has already been canvassed by the public. To take an example from the discussion in Parliament, public opinion on B.B.C. variety programmes is relatively mature; but on the question of whether it is better to fetch our own milk cheaply or to pay a little for delivery, opinions must have been collected from people to whom the question had never before occurred and who had never discussed it among themselves. (Further, the question seems to have been asked at a time of year when the mornings are light and the weather is fine.)

In the main, this method of inquiry has established itself through the belief of business men that market surveys do give them the information that they need for their sales policies. But it has to be remembered that in market research pure inquiry is never for long dissociated from efforts at moulding opinion. It is immediately followed by extensive advertising and propaganda which, in presupposing the truth of the survey findings, may in fact make them true. In the political field the same necessity to follow inquiry by persuasion will always make it difficult to test the findings of the inquiry. The uncertainty of these methods must not be exaggerated. But it should be realized that there is scope for much improvement before they can be regarded as scientifically mature.

Welfare of Aliens

An Advisory Council of Aliens has been appointed by the Secretary of State for Foreign Affairs. This Council, which is under the chairmanship of Lord Lytton, and will work in close association with the Foreign Office and other departments concerned, will advise the Home Office on the general welfare of interned aliens, make recommendations on finding employment for internees, and suggest measures for maintaining their morale and binding them more closely to the cause for which Great Britain is fighting.

A Home Office White Paper (Cmd. 6217. London: H.M. Stationery Office. 1*d.*) has been issued showing the conditions under which German and Austrian refugees at present interned may be released. The regulations now issued apply only to "C Class" internees, but it is stated that they are not to be regarded as final. Among those who may now apply for release are those who occupied key positions in industries engaged in work of national importance, skilled workers in agriculture, commercial food-growing and forestry, and scientific and other research workers and persons generally with academic qualifications for whom national work in their own fields is available. With regard to the latter groups, special committees are being set up by the vice-chancellors of the universities, the Royal Society and the British Academy to consider applications and to submit recommendations to the Home Secretary. These new regulations seem to provide the necessary safeguards of national security required in any relaxation of the order for general internment of aliens, and should meet with general approval.

An International Labour Force

Speaking in the House of Commons on August 1, Mr. Bevin, Minister of Labour, announced that he has set up an International Labour Branch as part of the employment department of his Ministry. The purpose of this branch is to organize the man-power of allied nations and of other well-disposed persons of foreign nationality in Great Britain. It is hoped to obtain full knowledge of those available for employment and to seek suitable openings for them in industrial and other work. Co-operation is to be maintained with the Allied Governments and other national authorities in Great Britain, and Mr. Bevin also hopes to have the advice of representatives of trade unions of foreign countries. He was very emphatic that the new branch would have nothing to do with internees; release of aliens and their supervision generally is a matter for the Home Office. Once an individual has been passed by the Security Department, then he becomes available for consideration by the Ministry of Labour. At this stage, Mr. Bevin said he proposed to dispense with the terms 'aliens' and 'refugee', and to refer to such individuals as an 'International Labour Force'. This development, coming at the same time as the announcement of limited release of German and Austrian refugees, shows that the problem of dealing with the unfortunate people who have been driven from their homes by Nazi and Fascist persecution is being given careful consideration. They have come to Great Britain for freedom, and while they will recognize that the special needs of the times make restrictions of various kinds necessary, they will appreciate the opportunity which is now to be given them of taking an active part in the struggle against totalitarian domination.

Sales Tax on Books and Periodicals

The case for withholding the imposition of the proposed purchase tax from printed books and periodicals was put before a private meeting of Members of Parliament held on August 6. As a result of the meeting, Mr. Kenneth Lindsay obtained support for an amendment which he is to submit proposing to omit printed books, music, pamphlets and leaflets from the schedule of taxable articles, and P. J. Loftus put forward another amendment which would exempt weekly, monthly and quarterly technical, scientific and trade journals retailed at not less than 6d. An amendment to exempt newspapers and periodicals is to be moved by Mr. Mander. Nature has already discussed the probable effects of the imposition of a sales tax on books and other publications (May 11, p. 719, and August 3, p. 160). On general as well as scientific grounds, the imposition of a tax on books is a bad thing, which even at the present time cannot be justified on grounds of financial expediency.

African Studies and the War

Lord Lugard, as chairman of the Executive Council of the International Institute of African Languages and Cultures, announces in the current issue of *Africa* (13, 3; July 1940) that the work of the Bureau and the publication of its periodical *Africa* must now cease for the duration of the War. In October last it was stated that it was hoped to carry on the Institute's work without serious interruption. Recent developments, however, have made international co-operation impossible, and it has been deemed advisable in the circumstances to cease work until after the War. Certain of the special publications of the Institute, which have proved so valuable to students of African peoples, are in an advanced stage of preparation and will be published as soon as possible—a book on African political systems, recently published by the Institute, is discussed on p. 188 of this issue of Nature. Further, several research fellows are engaged in writing up their field-notes. Dr. Nadel's notes on the Nupe of Northern Nigeria, and those of Mr. and Mrs. Krige on the Lovedu of the Northern Transvaal have been completed; but Dr. Margaret Read is still engaged on the results of her research in Nyasaland, and more especially on the part she took in the recent nutrition survey of that territory.

While those who have followed the work of the Institute, more especially since the receipt of the generous grant for field-work from the Rockefeller Trustees, will deeply regret this interruption, temporary though it may be, in its activities, they must, of course, accept the facts of the situation and realize that the international co-operation which has given its deliberations breadth and understanding is now an impossibility. At the same time, it would seem desirable that the intermission of activity should not be complete. It is generally conceded that the time for planning for peace is now, and not at the close of hostilities. This applies no less to Africa than to Europe. A planning that begins with the peace will be too late to cope with the changes in African societies, which if the aftermath of the War of 1914–18 is a criterion, will ensue all too rapidly.

Storage of Electric Power in the Ruhr

THERE has been a rapid increase in recent years in the use of electricity in steel manufacture in Germany. This 'electric steel' has a very uniform structure, but, if the cost is to be comparable with that produced by other means, the factor of safety has to be reduced. With so many high-frequency furnaces going intermittently, the power supply systems must be subjected to considerable peak demands. This is especially the case in the Ruhr, where, although there is a plentiful supply of coal, considerable reliance is placed upon the water-generated supplies from Austria to meet the heavy peak demands. The largest and one of the most interesting of the storage stations is situated at Herdecke on the banks of the Rhine about six miles south of Dortmund and nearly twenty miles east of Essen. It is connected with the control point at Brauweiler, which is on the Rhine between Cologne and Dusseldorf. By accumulating water in an elevated reservoir by means of pumps and the erection of the Herdecke power storage station and others in the district, the peak-load problem has been solved satisfactorily. Interesting details of this station are given in the *Electrician* of July 26.

The upper reservoir of the Herdecke plant, covering an area of 18 acres, is designed to permit the full development of the available power. The maximum variation in water-level from empty to full is 65 ft. The maximum pressure head between the lower reservoir, Lake Hengsty, and a full upper reservoir is 540 ft., and the minimum head available is thus 475 ft. The power house is 500 ft. in length and each machine has an axial length of 85 ft. The station can be automatically switched from pumping to turbine operation in two minutes, and during pumping the turbine discharges are closed by means of flaps. The upper reservoir is oval in shape and is about 800 ft. above sea-level; this necessitated the excavation of 1,300,000 cubic yards of rock. The entire concrete surfaces coming into contact with water have been rendered impervious by means of a bitumen spray treatment. The work was commenced at the beginning of September 1927, and the station was brought into partial operation in December 1929, full operation following about a year later. The characteristic feature of this type of station is that at times of low power consumption the waste current of the water stations, or the increased night output of the steam stations, is employed to pump water back into the storage reservoir.

This Season's English Herbs

MORE than usual interest will be shown this season in the English harvests of vegetable drugs, and it is now possible to judge from reports by herb farmers on the prospects of their crops what the harvests are likely to be, provided weather conditions for collection are favourable. Fair supplies are promised of those old-fashioned medicines such as hyssop, rue, wormwood, comfrey, balm and dill, but the same cannot be said of chamomile, the prospects of which are disappointing, an outlook that is all the more unfortunate since it is impossible to obtain supplies from Belgium. Indeed, it would seem that those who have pinned their faith, in the past, to chamomile tea will have to try one of the more modern remedies which are not so scarce. What is still more unfortunate is that on some herb farms the severe frost last winter destroyed the main belladonna plantations so that very little leaf—which is so badly wanted because of the absence of imports of the Continental plant—could be collected this season. It is satisfactory to know that the young belladonna plants of this year's sowing are looking well.

Growers of henbane report that there was a good crop of second-year biennial plants, and leaf and flower of good alkaloidal content have been harvested; after a time of drought, rain came to save the first-year seedlings, which will provide leaves for autumn drying. Prospects of a crop of high-testing digitalis leaf are favourable. Aconite is said to be looking well and there is a full crop of valerian. Having regard to the stoppage of supplies of lavender oil distilled in the Grasse district of the Alpes Maritimes, it is well to learn that English lavender plants stood up well to the hard winter and the flowers have bloomed earlier and, in some cases, better than usual; a fair yield of English lavender oil may be expected for this season; more of the flowers will go to the still and less to Covent Garden in bunches for street vendors, and thus at least part of the shortage due to the lack of French oil will be made good.

Notation for Tapping Systems of the Rubber Tree

THE scientific groups dealing with rubber production in Ceylon, Malaya and Netherlands East Indies have recently adopted a common notation for expressing the varied tapping systems by which the crop from Hevea is obtained. Attention was directed by Evan Guest, of the Rubber Research Institute of Malaya, to the confusion and ambiguity which existed because different centres had developed their own nomenclature without plan, and his suggested scheme, modified by the co-operation of others, has now been accepted (*J. Rubber Research Inst. Malaya*, 9, 142–170; 1939: 10, 16–33; 1940). This will mark a great advance in co-ordination of scientific records of yields from Hevea, for the fundamental factor, namely, intensity of tapping, is simply and accurately brought into the required prominence.

First the type of cut is identified by an initial letter, followed by the figure expressing the fraction of the tree circumference which is covered. Then the periodicity of tapping and resting is expressed by further fractions showing the frequency of tapping and the relation of tapping to resting periods. Finally, simple conventions define the arrangement of the panels, a matter which assumes special importance for the multiple cuts of the so-called slaughter systems by which old trees are drained before re-planting. Standard intensity is defined as a half spiral tapped alternate days without rest (that is, equivalent to one quarter cut per day) and the relative intensity of the system is easily arrived at by scanning the formula. As examples: "$S/1$, $d/3$, $4m/6$, 89%" signifies a full-circumference spiral cut tapped every third day for a period of four months in a cycle of six (two months rest), giving 89 per cent of the standard intensity; or "$S/3$, $d.2$ ($3 \times 6m/18$) 67%" indicates three panels of one third spiral cut, each one being tapped every second day for six months taking them in rotation. The amount of tapping can be expressed in circumference units (fractional length of cut multiplied by number of tappings), using the actual instead of the ideal number of tappings.

Most rubber estates keep full records which should potentially be a voluminous source of information, but the variables are so many and have in the past been so hazily defined that the scientific value of such records has often proved disappointingly small. Guest's notation will mark a great step forward in the task of making records both intelligible and comparable.

Golf Green Research and the War

THE revised values which the war places upon various activities have caused the managers of the Board of Greenkeeping Research to review the position of the Research Station at St. Ives, Bingley, Yorks. The experimental plots at this centre have been built up over a period of eleven years, at a cost of more than £26,000, and have provided valuable new knowledge about the ecological interaction of plants grown in compact formation, and about the practical treatment of greens. Much of their scientific value lies in their long term of treatment, and it is gratifying to learn that they are to be carried on, even if the need for economies should curtail the Station's other activities. It is also useful to remember, in the present intensity of the war effort, that the Station has contributed to a fundamental understanding of grass ecology which could be applied to increase food production on some of the poorer grassland of British uplands. Its researches on pests and diseases of grassland could quickly be turned to the aid of agriculture, and the Station has further adapted itself to war conditions by working on the best methods of pasturing sheep on golf courses, and giving advice upon minimum upkeep during the present difficult times.

Practical Applications of Horticultural Research

IN time of war there is a special need for the dissemination of the findings of scientific research, and in no field is this more true than in agriculture and horticulture. The application of known facts is often more important than the making of new discoveries. Following this principle, the John Innes Horticultural Institution is preparing a series of leaflets embodying in condensed but adequate form the results of some of the most practically important lines of investigation which have been followed in recent years. The first three of these leaflets have already appeared and deal respectively with the John Innes composts, soil sterilization for pot plants and the John Innes soil sterilizer.

Every horticultural grower is aware of the valuable work done by the Institution in devising two standardized composts, one for seed sowing and one for potting. These composts replace the bewildering array of mixtures recommended in horticultural text-books and may be used with success for every class of plant. No less important is the work of the Institution on the sterilization of potting soils, which has amplified and extended that of the Cheshunt Experimental Station. The principles of sterilization as applied to the John Innes composts are outlined in Leaflet No. 2, while No. 3 gives details of the home construction and the use of the specially designed John Innes soil sterilizer.

Prof. Richard von Krafft-Ebing

PROF. RICHARD VON KRAFFT-EBING, an eminent German psychiatrist and a pioneer in the scientific study of sex, was born at Mannheim on August 14, 1840. He received his medical education at Heidelberg under Fredreich and at Zurich under Griesinger, and after qualifying at Heidelberg in 1863 spent five years as an assistant in the Illenau Asylum. In 1872 he was appointed professor of psychiatry at the recently founded University at Strasbourg, and in the following year he accepted an invitation to occupy the corresponding chair at Graz, where he remained until 1889, when he succeeded Leidesdorf at the First Psychiatric Clinic at Vienna. In 1892 he succeeded Meynert at the Second Psychiatric Clinic, which he directed until his retirement in 1902. He died on December 22, 1902.

Kraft-Ebing was equally eminent as a research worker and clinical teacher, and gained a well-merited reputation not only as a psychiatrist but also as a criminologist and neurologist. He is best known for the work entitled "Psychopathia Sexualis", of which the first edition appeared in 1886 and the seventeenth posthumously in 1924. It was translated into English, French and Italian. His other works were "Melancholie" (1874), "Lehrbuch der Psychiatrie" (1879) which was translated into English and French and went through seven editions, and "Eine experimentelle Studie auf dem Gebiete des Hypnotismus" (1888), which was also translated into English. At the International Medical Congress at Moscow in 1887 he read an important paper on the causation of general paralysis which, as the result of his own experience, he proved to be the joint product of "syphilization and civilization". He was an honorary member of the medico-psychological societies of London, Paris, Rome, Amsterdam, Moscow, New

York and Chicago. A monument was erected to him in Vienna in 1908, when an address was delivered by his successor, Prof. Wagner von Jauregg.

Palæozoic Coral Genera

A COMPLETE list of the Palæozoic coral genera has been carefully prepared, correctly named, and supplemented by references to authors, synonyms, localities and published works ("Index of Palæozoic Coral Genera." By William Dickson Lang, Stanley Smith and Henry Dighton Thomas. Pp. vii+231. London: British Museum (Natural History), 1940. 15*s*.). Genotypes are arranged in the alphabetical order of the trivial names, followed by the generic name and its author. In the list of literature it is useful to have a record of the genera described in each work. Dr. Lang presents the list as the foundation of future work on the phylogenetic classification of the corals. Although he examines critically the gradations and trends among Tabulate and Rugose corals, he and his collaborators leave the interpretation of the facts to others. The most laborious part of the task has, however, been performed for them. More than fifty generic names are pre-occupied by members of other phyla, and of the corals themselves, nearly twenty names are *nomina nuda*. This sifting and purifying should be of lasting benefit to workers on the group.

Intelligence among Australian Aborigines

THE difficulties of applying intelligence tests to primitive peoples with a view to comparative study are notorious, and much ingenuity has been employed in devising tests which are immune from the vitiating factor of differences in the cultural background of the individuals or groups which it is sought to compare. The pioneer work of Dr. S. D. Porteous among Australian aborigines may be recalled in this connexion. Even more remarkable results, however, have been obtained by a recent expedition to the north-western regions of the Continent, sent out by the University of Western Australia, and consisting of three members of the Psychology Department, Mr. N. G. Trayten, Dr. D. W. McElwain and Dr. H. L. Fowler. Under the advice and with the co-operation of Dr. D. S. Davidson, assistant professor of anthropology in the University of Chicago, experiments were made in the application of intelligence tests which had not previously been tried with the Australian aborigines.

Not only was it desired to determine whether these tests were likely to prove more suitable for work with primitive peoples than those generally in use, but also whether they appeared to confirm the low estimate of aboriginal intelligence afforded by previous investigations. In a preliminary report on the work of the expedition, Dr. Fowler (*Australian J. Ser.*, 2, 5; 1940) records that, of the various tests applied experimentally, the Alexander Passalong test, involving the arrangement of coloured blocks in boxes, the Ferguson form boards, in which insets have to be placed in proper position, and the cube construction test, proved the most suitable, the second being the most satisfactory. Eighteen males and thirteen females were tested. They were of different ages, all but four being adults. In the results the interesting point lies not so much in the average mental age attained as in the range over which the scores spread, while considerable variation was noted in the different tribes. Still more remarkable is the fact that eight of the subjects in one test and five in another scored a mental age of fourteen or over, which indicates that they are at least at or above the level of the average white adult. From these results, which are in agreement with opinions expressed by squatters as to aboriginal abilities, Dr. Fowler draws the conclusion that further investigations should be undertaken in order that, if these preliminary results are confirmed, steps may be taken to foster the development of such abilities.

Roadwork and Bridges in Hungary

FOLLOWING its established custom, the municipal administration of Budapest has again called for tenders for dust-proofing the macadamized roads in the city. According to *Roads and Road Construction* of July, the proposal was to treat 522,000 sq. kilometres of roads with oil while the remaining 320,000 sq. kilometres of road requiring dust-proofing treatment would have been treated with tar. The bids proved that the price of oiling would have been one third higher than last year, while contractors also insisted on various disadvantageous clauses and conditions. The municipality has therefore decided to apply dust-proofing treatment to a total of 550,000 sq. kilometres of road surface only, using tar throughout. The Ministry of Commerce has issued a series of important commissions for the construction or reconstruction of roads and for two new bridges spanning the Danube and the Tisza respectively. The total commissions amount to well over seven million pengoes.

The new bridge over the Danube at Medve will cost more than two million pengoes, while that over the Tisza, in the Hungarian lowlands, will cost nearly 860,000 pengoes. The Danube bridge will be erected by the Hungarian Waggon and Machine Factory, while that on the Tisza will be built by Ganz and Company, of Budapest. The number of road contracts so far allotted is fourteen, and they have been awarded to the same number of different firms, partly to joint stock companies and partly to individuals. The majority of the roads will have concrete surfaces, although a few will have stone surfaces. The total amount of the fourteen orders is about 500,000 pengoes.

Swiss Postal Railway

IT is stated in the *Bulletin* of the Oerlikon Co. that an underground railway has recently been built in Zurich for the conveyance of letters and express packets between the branch post office at the main railway station and the Sihl post office, which are about three quarters of a mile apart. The railway is practically automatic. A driverless electric track is set in motion by pressing a push button on the main control panel. At the railway station terminus the track runs on to a lift, which operates automatically, rising to the level of the post office above. The railway is operated by a three-phase 220-volt, 50-cycle supply. This obviates the need for converter sets or special gear on the motor track for reversing. To reverse, all that is necessary is to interchange the connexions of two phases of the supply.

The motor-truck has two axles, one of which is coupled through gears to a 3·5 h.p. three-phase induction motor, giving the truck a speed of 14·4 ft. per sec. The other axle is driven by a 1 h.p. motor for running at low speed (0·98 ft. per sec.). The latter motor is brought into operation at the stations by means of an electro-magnetic coupling controlled by a change-over switch, which is actuated by a roller contacting with a third rail in the station sections. The truck is fitted with a mechanical brake operated by spring force. The order for the whole installation was placed with the Oerlikon Co.

Catalogue of Meteorites

The British Museum (Natural History) Catalogue of Meteorites was issued in 1923 and a first appendix appeared in 1927. A second appendix, compiled by M. H. Hey, has now been published by the Trustees of the Museum (1940, pp. 136, price 5*s.* net). It includes particulars of all meteorites described since the appearance of the first appendix up to the end of September 1939. Additions and corrections to some of the earlier entries have been made and a separate list of meteorite craters has been included. It is interesting to note that the catalogue and its appendixes now contain entries for 1,251 reasonably well-authenticated falls, of which 758 are represented in the Museum collections, and for a further 98 'doubtful' and 'paired' falls, of which there are 24 in the collections. Of the 51 'doubtful' falls, a few may not be meteorites, others have never been adequately confirmed or described, and others may have names that may be synonymous with those of falls otherwise recorded. The 47 'paired' falls are pairs or groups of falls which are possibly or probably identical; these have been counted only once in the totals. Falls reported in ancient histories and objects of worship in ancient temples thought to have been meteorites have not been included, except in the case of *Jalandhar*, which fell in the Punjab in 1621 and was forged into sword blades; in other cases the data are too vague and uncertain.

Extra Fat Allowance for Diabetics

Mr. Boothby, Parliamentary Secretary to the Ministry of Food, has stated in the House of Commons that the Food Rationing (Special Diets) Advisory Committee of the Medical Research Council has advised the Minister of Food that persons suffering from diabetes mellitus should be allowed two extra butter and margarine rations, totalling 12 oz., each week. The necessary arrangements for the issuing of the supplementary rations by food executive officers has been made.

Recent Earthquakes

On July 30, violent earthquakes occurred on the central plateau of Anatolia. Twelve villages including Peyk were destroyed near Yozgad, the shock also being felt at Ankara, Erzinjan, Tokat, Kayseri, Amasya, Sinop, Istanbul and intervening places. Three hundred people are reported to have been killed and several hundreds of others injured. The epicentre of the shocks appears to have been near Yozgad, which is not far from Erzinjan, the centre of the greatest of all Turkish earthquakes on December 27, 1939 (Nature, January 6, p. 13). The present shocks cannot be considered as aftershocks of the December 27 earthquake nor are they so intense, but they point to the same general instability of the whole region at the moment, of which all the shocks are the result. It must also be noticed that such a terrific earthquake as that of December 27 would itself give rise to instability which would persist for a considerable time and give rise to earthquake shocks in general not so intense as the original one. Aftershocks of the earthquakes of July 30 were continued on the next day.

An earthquake of considerable severity was experienced in western Hokkaido on August 2. The full extent of the damage caused by the shock is not yet known, but more than a thousand fishing boats were damaged by a huge wave which followed the earthquake, seeming to point to an off-shore epicentre between Hokkaido Island and the mainland of the continent of Asia.

Announcements

Mr. R. C. Morrison, M.P., has been appointed chairman of an interdepartmental committee to secure greater liaison between the activities of the Ministry of Supply, which is responsible for the salvage campaign, and other services and departments.

The Adelaide meeting of the Australian and New Zealand Association for the Advancement of Science arranged for August has been postponed. The position will be reviewed when it is considered that conditions may be favourable for the holding of a meeting.

Awards are made from the Sir George Beilby Memorial Fund at intervals determined by the administrators, representing the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals. Preference is given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. In general, awards are not applicable to workers of established repute, but are granted as an encouragement to younger men who have done original independent work of exceptional merit over a period of years. The administrators of the Fund will be glad to have their attention directed to outstanding work of the nature indicated, not later than November 1. All communications should be addressed to the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W.C.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Mucolytic Activity of Diffusing Factor Preparations

Chain and Duthie[1] have observed that aqueous testicular extracts contain a mucinase which rapidly reduces the viscosity of synovial fluid and causes an increase in the reducing power of this material. They suggested that the diffusing factor in testicular extracts might be identical with this mucinase and that the spreading effect in the skin might be due to rapid hydrolysis of interfibrillar mucin. This at first sight attractive hypothesis has been accepted by several workers[2,3,4], although no evidence has been advanced of the identity of the two effects, other than the known fact that snake venoms and bacterial filtrates, both well-known sources of diffusing factors, also show mucolytic activity.

Recent improvements in the biological test for diffusing factors[5] and an accurate viscosimetric method for the assay of mucolytic activity[6] have made it possible to compare the degree of activity shown by the various diffusing factor preparations when assayed by both methods. Dry preparations from bull testicle and rattlesnake venom were used and some results are given in the accompanying table.

Preparation	Diffusing potency (% standard)	Mucolytic activity (% standard)
Glaxo Laboratories standard (testicle)[5]	100	100
Madinaveitia standard (testicle)[7] ..	68	24·6
Dialysed extract (testicle)	48	80
$(NH_4)_2SO_4$ purified extract (testicle)	58	149
Crude *Crotalus atrox* venom ..	5·35	18·4
Purified *Crotalus atrox* mucinase ..	4·9	61·1

While these results are only of a preliminary nature we feel that they are sufficiently clear to warrant publication at this stage. It seems that there is no parallel between diffusing factor potency and mucolytic activity in the materials examined. Moreover, Meyer and his colleagues have recently encountered a similar absence of correlation[8]. While it cannot be said that diffusing factors are therefore not in some way related to mucinases, it seems certain that the method of assaying diffusing factors by merely measuring their mucolytic activity is open to grave objection. The possibility of a complete separation of diffusing factor from mucinase is the subject of investigations now in progress.

J. MADINAVEITIA.
A. R. TODD.

Chemistry Department,
University of Manchester.

A. L. BACHARACH.
M. R. A. CHANCE.

Glaxo Laboratories Ltd.,
Greenford, Middlesex.
July 10.

---

[1] Chain and Duthie, NATURE, 144, 977 (1939).

[2] Meyer and Chaffee, *Proc. Soc. Exp. Biol. and Med.*, 43, 487 (1940).

[3] Favilli, NATURE, 145, 866 (1940).

[4] McClean and Hale, NATURE, 145, 866 (1940); *Chem. and Ind.*, 59, 347 (1940).

[5] Bacharach, Chance and Middleton, *Chem. and Ind.*, 59, 348 (1940).

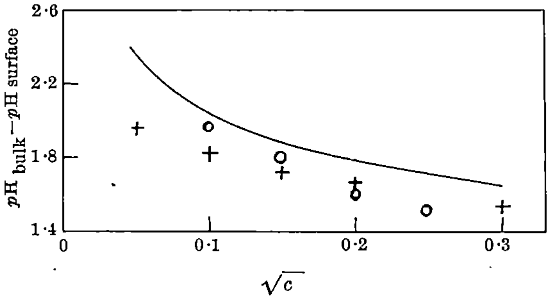
[6] Madinaveitia and Quibell, *Biochem. J.*, 34, 625 (1940).

[7] Madinaveitia, *Biochem. J.*, 32, 1806 (1938).

[8] Meyer, Hobby, Chaffee and Dawson, *Proc. Soc. Exp. Biol. and Med.* 44, 294 (1940).

Concentration of Cations at Negatively Charged Surfaces

WHEN ions of one sign are fixed at a surface, the concentration of ions of the opposite sign in the surface phase may be calculated from the Gibbs-Donnan equilibrium between the surface and bulk phases[1], or from the electrokinetic potential. By both methods it is predicted that the pH at a surface containing fixed anions will be less than in the bulk phase, and Hartley and Roe have shown[2] that the pH at the surface of cetyl sulphate micelles, as calculated from the ζ potential (circles of accompanying figure) is in reasonable agreement with the values observed using a surface colorimetric indicator (crosses of accompanying figure). We have now calculated the pH at the same surface from the Gibbs-Donnan equilibrium (continuous line of accompanying figure) and find values in reasonable agreement with those obtained by the other two methods. The thickness of the surface phase was taken as that given by the theory of Debye and Hückel.



Wilbrandt has suggested[3] that the Gibbs-Donnan equilibrium can also be used to calculate the distribution of Na+ and Ca++ between a surface and a bulk phase. We have studied this by chemical analysis of palmitate monolayers spread on solutions containing varying concentrations of Na+ and Ca++. As predicted by the Gibbs-Donnan relationship, there is a lower Na : Ca ratio in the surface than in bulk, but the ratio found is much less than the predicted value (see accompanying table), which suggests that Ca++ may be bound at the interface by other forces in addition to that of simple electrostatic attraction.

MOLAR RATIO NA : CA IN MONOLAYERS OF PALMITATE SPREAD ON 0·1 *N* SALINE.

Ratio in saline	100 : 1	200 : 1	400 : 1	2000 : 1
Ratio found in monolayer	0·13 : 1	0·18 : 1	0·27 : 1	0·31 : 1
Ratio calculated from Gibbs-Donnan equation	4·5 : 1	8·2 : 1	15·5 : 1	109 : 1

The negatively charged surfaces act as reservoirs of divalent ions, and the discharge or dissolution of these surfaces will release a disproportionate amount of divalent ions. Such reservoirs may be the source of the intracellular free calcium released by stimulated cells[4].

D. A. WEBB
(Overseas Scholar of the Royal Commission of 1851).
J. F. DANIELLI
(Beit Memorial Medical Research Fellow).

Sir William Dunn Institute,
Tennis Court Road,
Cambridge.
July 11.

---

[1] Danielli, *Proc. Roy. Soc.*, B, **122**, 155 (1937).

[2] Hartley and Roe, *Trans. Faraday Soc.*, **36**, 101 (1940).

[3] Wilbrandt, *Verh. Schweiz. Physiol.* (July 1939).

[4] Heilbrunn, "An Outline of General Physiology", Philadelphia (1937).

Cosmic Rays and Poisson's Law

LET us consider a great number n of events of a sequence the mean value of which is $\bar{n}$. If these events obey Poisson's law, the probability of actual realization of the nth event is

$$P(n) = \frac{\bar{n}^n}{n!} e^{-\bar{n}}$$

In the case of cosmic rays, $\bar{n}$ would be the mean value of the number of cosmic rays registered during the same interval of time by a counter during a long interval, and n any number of rays registered in one interval by the same counter, the probability $P(n)$ of which is to be ascertained.

But Poisson's formula can be applied only if: (1) the probability of the event considered is very small (less than 0·1); (2) the frequency is never less than 10; (3) the events considered are independent.

The two first conditions are certainly fulfilled by the numbers of cosmic rays, the second one depending on the time of computation only. Therefore we shall deal with the third condition, which is essential. Indeed, it often occurs that a slight dependence entails extensive modification in the theoretical distribution based on the independence.

We tried to show the independence of the numbers of cosmic rays registered during the same interval of time, which was a quarter of a minute. The following method[1] was adopted. The registered values were grouped in three series: 'chronological series' (sequence of values as obtained); 'ordinal series' (sequence of values classified in increasing order); and 'series of consecutive values' (sequence of values which follows each observed value). Each of the two latter series is decomposed into decils, that is, into ten equal parts, numbered from 1 to 10, and from I to X. The probability that one value taken at random in the chronological series should belong to either decil of either group must be 1 : 10. Consequently, if there is independence, the probability that the same value should belong at the same time to two decils, one in the 1–10 group, the other in the I–X group, should be 1 : 100.

We had 1,600 numbers registered. Therefore, should we have each number with two indexes, one taken from the 1–10 group and the other from the I–X group, the result would be 100 groups of values, allowing for Bernoullian fluctuation $\mu^2 = npq = 16$. We arranged the following table:

	I	II	III	IV	V	VI	VII	VIII	IX	X
1	24	13	18	17	12	21	16	10	13	16
2	22	21	22	8	22	11	17	14	14	9
3	15	10	24	18	19	18	8	21	17	9
4	19	11	13	28	4	17	25	14	11	18
5	6	19	19	9	34	11	6	19	14	23
6	20	19	11	18	5	28	11	12	17	18
7	16	9	12	16	9	20	22	17	20	18
8	13	21	10	13	25	12	16	16	19	15
9	12	20	18	8	22	9	19	19	16	17
10	12	17	13	25	7	12	20	18	19	17

The table shows that 53 values are outside the theoretical limit 16 ± 3. The difference is of the same order of magnitude as the one M. Ferber found for the intervals between the emissions of the alpha particles of polonium[2].

The experimental proof of the hypothesis of independence has not therefore been obtained; and it seems that there is a correlation which, though feeble, renders doubtful the legitimacy of application of Poisson's law to the registered numbers of cosmic rays. On the other hand, the existence of four hyponormal groups (5–VI, VII), (6–VII, VIII), (7–II, III), (10–V, VI) confirms our conclusions, as according to the hypothesis of independence only one of these groups was to be expected.

Finally, the high values in the squares of the main diagonal of the table suggest the existence of many pairs of consecutive values of the same order of magnitude.

I am indebted to Prof. A. Cyrillo Soares for much valuable advice and assistance, and to the Instituto para a Alta Cultura for material support.

A. GIBERT.

Laboratório de Física,
University of Lisbon.
July 11.

---

[1] Eyraud, H., *Ann. l'Univ. de Lyon*, 3° série, Sciences, Section A, 30 (1936).

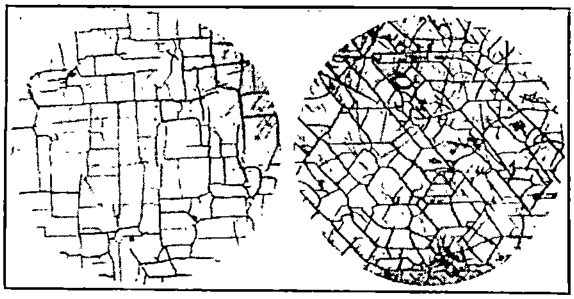
[2] *J. Phys.*, **10**, 134 (1939).

Etching Reagent for Chromite

THE resistant nature of chromite to all the usual etching reagents used in polished section examination is well known. Etch patterns on chromite would assist in the determination of the orientation of interlocking and anhedral grains in a rock and in the recognition of zoning. A search for a suitable reagent has revealed that chromite can be etched by treatment with concentrated perchloric acid, which is not mentioned in standard works on mineragraphy.

Polished sections approximately 2 cm. square were prepared on a billiard cloth lap or on a Graton-Vanderwilt polishing machine. The former method gives a satisfactory polish with most chromite specimens and is preferred, as it is necessary, before etching, to remove the bakelite mount used in the latter method.

The polished section is placed face downwards in a crucible of a size such that the specimen does not quite rest on the bottom. Sufficient perchloric acid to immerse the lower part of the specimen is added. For the size of specimen used, a No. 0 Royal Worcester porcelain crucible and 2–3 ml. of 70 per cent perchloric acid are satisfactory. The crucible is heated until the acid begins to fume, and the temperature is maintained until all the acid has evaporated. It is desirable to continue heating for about five minutes longer.



ETCHED CHROMITE: LEFT, CUBE FACE; RIGHT, OCTAHEDRAL FACE. × 400.

A first treatment may reveal no etching effects, and the procedure may have to be repeated several times. The depth and width of the etch grooves seem to depend to some extent on the short period of heating after the acid has evaporated, and great care must be taken to avoid disintegration of the polished surface by prolonging this final stage.

The perchloric acid often affects the cementing minerals and causes the polished surface to become extremely fragile. Parts of a section may fall out and etched specimens require gentle pressure when being cleaned. While chromite rocks with but little interstitial silicate minerals are not greatly weakened, those containing much gangue become rather more difficult to treat; nevertheless, even if only a few isolated chromite grains remain in the section, they can afford such data as may be required.

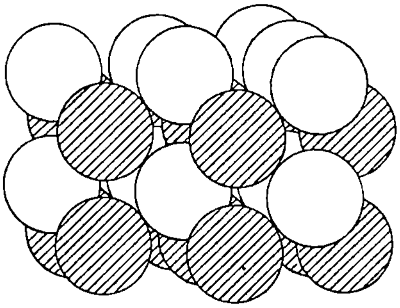
Polished surfaces parallel to the cube, octahedral and rhombic-dodecahedral faces of a large chromite crystal were prepared. The first-named face etched more slowly than the latter two. Cube and octahedral etch patterns are shown in the accompanying illustration.

J. J. FRANKEL.

Minerals Research Laboratory,
University of the Witwatersrand,
Johannesburg.
June 12.

Symmetrical Arrangement of Equal Spheres

IN Barlow's paper[1] on the "Probable Nature of the Internal Symmetry of Crystals" he writes: "A fifth kind of symmetry . . . bears the same relation to the fourth kind as the second bears to the third; that is to say, it may be regarded as produced by the insertion of additional points in positions midway between points arranged in the fourth kind of symmetry". This is not so. Barlow did not describe or figure that arrangement which does bear the same relation to the fourth kind which the second bears to the third. It is shown in the accompanying figure. Its triangular base and first two layers are the same as those of Barlow's "second kind of symmetry"; but its third layer lies over the first, the fourth over the second, and so on. If now we insert additional points in positions midway between points in this structure, Barlow's "fifth kind of symmetry" is produced.



The new structure may be regarded as derived from the hexagonal close-packed assemblage by vertical compression and simultaneous dilation in horizontal directions. Similarly, compression of the cubic close-packed assemblage gives rise to Barlow's "second kind".

The elusive nature of the problem which Barlow set out to solve will be appreciated when it is recalled that P. G. Tait, examining the same subject, described two arrangements[2], supposed to be distinct, which are merely different aspects of the same thing (Barlow's cubic close-packed assemblage) and failed to discover the hexagonal close-packing.

SIDNEY MELMORE.

61 Carr Lane,
Acomb, York.

---

[1] Barlow, W., NATURE, 29, 186 (1883).

[2] Tait, P. G., *Proc. Roy. Soc. Edin.*, 4, 535 (1862), arrangements iii and iv.

Recombinants between Drosophila Species the F_1 Hybrids of which are Sterile

THE genetic analysis of species differences is of especial interest in precisely those cases where the sterility or inviability of the hybrids between the species stands in the way of such analysis. A notable case of this kind is that of *Drosophila melanogaster* and *simulans*, species which otherwise would present most favourable conditions for detailed analysis, on account of the already existing knowledge of the genetics of each species and the existence of abundant stocks providing suitable genetic tools ('markers'). We have found a means of circumventing the sterility of the F_1 hybrids between these species and thus obtaining types of the same kind as would be produced in a backcross of the F_1 hybrid, were it fertile, to *melanogaster*; it is at the same time possible to recognize, by means of the markers used, what combination of chromosomes is present in the pseudo-backcross progeny and thus to determine the effects of the different chromosome combinations.

The means used is to take triploid *melanogaster* females carrying recessive mutant genes in all their major chromosomes and to cross them with heavily irradiated *simulans* males bearing the dominant normal alleles of these genes. The triploid females produce eggs most of which have one or more of their chromosomes in diploid number. On the other hand the X-ray treatment, as we had found in earlier work with *melanogaster* alone[1,2], causes the loss of individual chromosomes, presumably by breakage, in some 5 per cent or more of the spermatozoa capable of giving viable offspring, although sperm in which two chromosomes have been simultaneously affected by a mutual translocation resulting in acentric and dicentric combination-chromosomes are incapable of giving viable offspring. When an egg with an extra chromosome or chromosomes happens to be fertilized by a sperm in which the homologous chromosome or chromosomes have been incapacitated, a viable diploid results, in which the chromosomes in question are of homozygous *melanogaster* type and the others are heterozygous as in the species hybrid. The kind of recessive character shown by the individual indicates which chromosomes are of homozygous *melanogaster* type. The resemblance to a backcross fails only in that the chromosomes are inherited as units; that is, there has been no opportunity for crossing-over.

Some 350 progeny have been obtained from this pseudo-backcross. The majority of the types of recombinants prove to be viable, although most have a viability considerably below normal. The inviability of hybrids bearing no *simulans X*, reported by Sturtevant[3] in 1920, proves to be due to interactions of genes in the *X* with those in both the second and third chromosomes, but more especially with the latter. Thus it has been possible to obtain viable adult hybrids without a *simulans X* but with a *simulans* II, and also (but not so readily) those without a *simulans X* but with a *simulans* III, when the other pair of major autosomes (III or II, respectively) is purely of *melanogaster* type. Study of the frequencies indicates the existence of several inter-chromosomal viability interactions. Similarly, it can be concluded that there are several interacting genes affecting fertility, as all viable recombinants of the major autosomes show sterility, although the degree of reduction of the gonad is (as shown by histological studies, carried out by Koller) different for the different chromosome combinations. The chief morphological abnormality of the hybrids—the bristle reduction and associated abnormality of the abdominal banding—proves to be due to interaction between a gene or genes in the *X* of *simulans* with an autosomal gene or genes of *melanogaster*, located at least in part in the second chromosome.

That the sterility and inviability effects are wholly chromosomal (and therefore Mendelian) in origin was shown by the obtaining of a single individual which happened to have all its major chromosomes from *melanogaster* and which alone, of all the progeny, proved to be fertile. The breeding of this individual to *melanogaster* has made it possible to transfer the fourth and the *Y* chromosomes into an otherwise purely *melanogaster* genotype. Here their *simulans* origin has been verified by cytological observations, carried out by Slizynski. Both chromosomes when in the *melanogaster* genotype show important genetic differences from their *melanogaster* homologues; a detailed analysis of these differences is in progress.

A full account of the above experiments and of the bearing of the results on problems of speciation is being prepared by us, and accounts of the histological and cytological observations will be published by Koller and by Slizynski, respectively.

H. J. MULLER.
G. PONTECORVO.

Institute of Animal Genetics,
University of Edinburgh.
July 18.

---

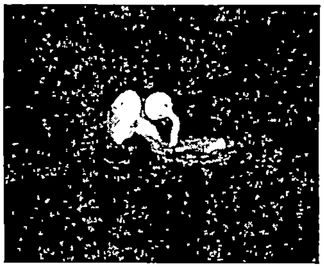
[1] Muller, H. J., *J. Genetics*, 40, 1–66 (1940).

[2] Pontecorvo, G., Ph.D. thesis, University of Edinburgh. 146 pp. (also Muller and Pontecorvo, unpublished) (1940).

[3] Sturtevant, A. H., *Genetics*, 5, 488–500 (1920).

Blind Seed Disease of Rye-Grass

REFERENCE has been made by Wilson, Noble and Gray[1] to the confusion existing in the nomenclature of blind seed disease of rye-grass. The causal organism has been referred to by Hyde[2] as Pullularia, and the trouble is often referred to as "Pullularia disease". It seems doubtful whether the conidial form of the causal fungus is Pullularia, and the position is complicated by the occurrence of Pullularia sp. closely associated with the blind seed fungus. Wilson *et al.*[1] have pointed this out and state that the blind seed fungus and Pullularia sp. may be present on one and the same seed. Our work confirms this; both organisms may be found when examining seed samples. The conidia are distinct; those of Pullularia are smaller in size and yeast-like in character, while those of the blind seed fungus are larger, allantoid, and more regular in size and shape. Whereas Pullularia is usually associated with the glumes and the exterior of the caryopsis, the blind seed fungus only occurs in and on the caryopsis. Pullularia has been isolated from the caryopsis, but not from caryopses surface sterilized before examination. It is always the blind seed fungus which has been obtained in such cases.



DEAD RYE-GRASS SEED BEARING TWO OF THE HELOTIUM-LIKE APOTHECIA, THE PERFECT STAGE OF THE BLIND SEED FUNGUS.

Experiments designed partly to determine the relative pathogenicity of these fungi have been concluded and the results are of interest. Turves of commercial perennial rye-grass were lifted and brought to the laboratory. When in full flower, a bunch of the heads in each turf was inoculated with spore suspensions in sterile water. The following spore suspensions were used: (1) conidia of Pullularia sp. isolated in Northern Ireland from rye-grass seed; (2) conidia of the blind seed fungus isolated in Northern Ireland from rye-grass seed; (3) conidia of the blind seed fungus isolated by Neill in New Zealand; (4) suspension of ascospores from Helotium-like apothecia growing from dead rye-grass seeds in the rye-grass field from which the turves were taken. (These apothecia bear a marked similarity to those described by Neill and Hyde[3] in New Zealand; this appears to be a first record of their occurrence outside New Zealand, and a photograph of a dead seed bearing two apothecia is reproduced herewith); (5) control —heads immersed in sterile water.

Inoculations were made on June 4 and an examination for disease on June 24–25. Five hundred seeds were examined from each batch of heads. The young caryopses were extracted and examined microscopically for the presence of conidia. The following results were obtained.

The seeds from the control batch were all healthy. No conidia of either the blind seed fungus or Pullularia were found. No diseased seeds were found in the heads inoculated with Pullularia.

The heads inoculated with the Northern Ireland strain of the blind seed fungus showed 10·6 per cent of the seeds to be severely affected with the disease. At the time of examination, the diseased seeds were dull brown in colour, soft in texture and apparently quite dead.

Inoculation with the New Zealand strain of the parasite gave similar results; the percentage of diseased seeds obtained was somewhat lower, being 5·4.

The seeds examined from the heads inoculated with an ascospore suspension from the Helotium-like apothecia were affected to the extent of 7·6 per cent; the infection was typical. It would therefore seem clear that the Helotium-like apothecium found on dead rye-grass seeds in the early summer in Northern Ireland is the perfect form of the blind seed fungus. Cultures raised from single ascospores resemble those of the blind seed fungus in all respects.

Other apothecia resembling the type on rye-grass seed have been found on vegetable detritus, etc., in rye-grass fields. None has been tested for pathogenicity, but ascospores from them have not produced cultures similar to those of the blind seed fungus. Apothecia on the basal leaf sheaths of standing rye-grass have also been found, and it is believed that this form may be that referred to by Neill[3] as Lolium fungus No. 2.

These results show that the blind seed fungus is the parasite responsible for blind seed disease of rye-grass in Northern Ireland and, in the main, confirm the pioneer work carried out by Neill and Hyde in New Zealand. They also indicate that the Pullularia sp. commonly found associated with diseased rye-grass seeds is not parasitic, and that its role is probably saprophytic. It therefore seems desirable, for the present, to dissociate the name Pullularia from this disease, and to refer to it only by the name suggested by Neill, namely, blind seed disease.

A. E. Muskett.
E. L. Calvert.

Ministry of Agriculture,
Plant Disease Division,
The Queen's University,
Belfast.
June 26.

---

[1] Wilson, M., Noble, N., and Gray, E. G., Nature, 145, 783 (1940).
[2] Hyde, E. O. C., *New Zealand J. Agric.*, 57, 301 (1938).
[3] Neill, J. C., and Hyde, E. O. C., *New Zealand J. Sci. Tech.*, 20, 281A (1939).

Structure of *Hemimerus deceptus* Rehn, var. *ovatus*, and the Classification of Dermaptera

I have carried out detailed work on the external and internal anatomy of Hemimerus, and find that the semi-parasitic mode of life of the insect has modified various structures in its anatomy, but that it still retains many primitive features.

The mouth parts have bilobed lingula. There is a prostheca on the mandibles, and a large pair of superlinguæ. Pleural sclerites are well developed, despite the apterous condition, and the mechanism of hiding the legs under the body is interesting. There is a well-developed peritrophic membrane in the stomach, and a complex grinding mechanism in the proventriculus. The spiracular openings have a primitive guarding apparatus and (with one or two exceptions) there is an absence of transverse tracheal commissures. The most remarkable feature of the reproductive system is the presence of two ejaculatory ducts opening separately on a single penis.

Jordan[1] was not sure of this dual nature of the ductus ejaculatorius, while Snodgrass[2] mentions the presence of two exit ducts. Burr[3] thought that one of these ducts was reduced and had created two separate sub-orders, namely, Hemimerina and Arixenina, for the reception of Hemimerus and Arixenia respectively. The classification of Dermaptera could be simplified by dividing it into two series only, namely, Protodermaptera (with two ejaculatory ducts), and Eudermaptera (one ejaculatory duct). Hemimerus could be amalgamated into the former and Arixenia into the latter, while the two sub-orders Hemimerina and Arexenina be eliminated.

The insect was procured from Tanganyika, and as it differs from the specimens of Rehn[4], it has been named *Hemimerus deceptus* Rehn, var. *ovatus*, and specimens have been deposited in the British Museum (Natural History). The intersegmental membranes of many specimens were full of the hypopial stages of a Tyroglyphid mite. It is hoped that a detailed account of this work will shortly be published.

P. J. Deoras.

Zoology Department,
King's College,
University of Durham,
Newcastle-on-Tyne.
June 10.

---

[1] Jordan, K., *Novitat. Zool.*, 16, 327 (1910).
[2] Snodgrass, R. E., *Smithsonian Misc. Coll.*, 96 (5), p. 42 (1937).
[3] Burr, M., *J. Roy. Micro. Soc.*, 413 (1915).
[4] Rehn, R. A. G., *Proc. Acad. Nat. Sci. Philadelphia*, 87, 457 (1936).

Colonel Kenneth Macleod

In the note on Colonel Macleod in Nature of July 20, p. 90, there is one omission which, I venture to think, should not go unremedied, namely, his description in 1881 of what he thought was a "new disease", in fact he called it the "New Indian Disease", allied to, but at the same time not identical with, beriberi; he gave it the name of "epidemic dropsy". He had observed it in Calcutta and its suburb Howrah from 1877 onwards. Though the etiology is even now not quite clear, Macleod's clinical description was so full and accurate that little has been added to it, and nothing has had to be taken away. This shows how great were his powers of accurate clinical observation.

A more detailed account of the condition is given in "A History of Tropical Medicine" (London: Edward Arnold, 1939), vol. 2, pp. 897 *et seq.*

H. Harold Scott.

Bureau of Hygiene and Tropical Diseases,
Keppel Street,
Gower Street,
London, W.C.1.

RESEARCH ITEMS

Li Tribes of Hainan Island

A PRELIMINARY study of the origin of the Li tribes of Hainan Island by Chungshee H. Liu appears in the first issue (January 1940) of *Meridio-Occidentale Sinense*, a newly established journal for the scientific study of south-west China published by the South-West China Society at Kunming, China. The Li tribes are first mentioned in the "Annals of the Han Dynasties" (206 B.C.–A.D. 219), and since have been known by various cognate names, themselves adding a labial which by a phonetic change might suggest a relation with "Malay". In some localities *Moi* points to a common origin with other aboriginal tribes of Indo-China; or again an affinity with the Lao of Tonkin has been suggested. There is reason to believe that the present Li tribes are descended from the Lii family or clan; but whether they had settled in Hainan before the Han dynasty or came to the mainland through Hainan demands further research. Physically the Li are a fine race of stout or slender build and medium stature (160 cm.). The skin is yellowish-brown, red-brown, or pale yellow; hair black, straight and fine; eyes medium brown, rarely light brown, oval, semi-oval or round in aperture, the eyefold being absent, but rarely traceable; nose concave or straight with more or less flat apertures. The cheek-bones are not prominent. The cephalic index is 80·20, the nasal index 75·73. In all these characters they differ from the Chinese, but are akin to Tai (Shan) on the one hand and Malay on the other. There has been, however, a generous admixture of Chinese blood. Racially they may be classified as Oceanic or Southern Mongols or Nesiots, or as Palæomongolides of von Eichstedt's new classification. The cultural relationship is complicated, but they appear to belong to the Indonesian cultural cycle. Linguistically their language belongs to the Thaic family.

Nutritional Oedema and Dietary Deficiency

J. B. YOUMANS read a paper on this subject at the Eighth American Scientific Congress on May 14. Nutritional oedema, long ago described under such names as famine oedema and starvation oedema, has, since the War of 1914–18, been known to be due to a lowering of the serum proteins caused by a deficient intake or an improper absorption or utilization of food. The disease appears epidemically, endemically, or as sporadic cases. Epidemic and endemic cases occur in populations subsisting temporarily or permanently on inadequate diets, particularly diets low in protein. Sporadic cases occur in patients with other disease which affects the intake or absorption of food. The principal clinical manifestation of the disease is an oedema of varying degree with few other signs and symptoms in uncomplicated cases. Diagnosis is made by the presence of the oedema, otherwise unexplained, associated with a decrease in the concentration of serum proteins, and a drop in the colloid osmotic pressure of the blood. A determination of the serum proteins may reveal a latent or preclinical stage of the disease before the oedema becomes manifest. Observations on the incidence and manifestation of the disease in the southern part of the United States are to be reported.

Damaged Starch and the Diastatic Activity of Flour

THE shearing and crushing in the roller milling of flour results in a particular type of damage to starch granules characterized microscopically by a curious flat appearance and faint outline (C. R. Jones, *Cereal Chem.*, 17, 133; 1940). Their attenuated outline in contrast to the boldness of some granules has suggested the term 'ghosts'. Congo red does not stain sound granules of starch, whilst 'ghosts' all stain orange pink. In general, it is found that in flours differently milled from the same wheat the order of abundance of 'ghosts' is in the same direction as the 'maltose' figure. The enzymes responsible for the diastasis in sound non-germinated wheat may be regarded as uniformly distributed over the endosperm. The soluble 'inner starch' is ordinarily protected by an envelope or skin of insoluble 'outer starch' surrounding the granule. The former alone is fermentable by the diastatic agent, which cannot act until the outer resistant skin of the granule is broken, and the 'ghosts' alone are therefore the source of sugar formation in dough. Differences in diastatic activity between flours from different types of wheat are not necessarily due to differences in amylase content or in starch susceptibility; they are at least partly to be explained by differences in the physical hardness of the endosperm, this in turn determining the extent of the damage to the starch during milling.

Origin of the Loganberry

THERE has been considerable debate as to whether the loganberry is a hybrid between the Californian blackberry, *Rubus vitifolius*, and the raspberry, as claimed by its raiser, Judge Logan, or whether the loganberry is an offshoot of *R. vitifolius*. M. B. Crane (*J. Genetics*, 40, 129–140; 1940) and P. T. Thomas (*J. Genetics*, 40, 141–155; 1940) have produced considerable evidence to support the theory of hybrid origin. Crane crossed *R. vitifolius* with a tetraploid raspberry and obtained a hybrid which resembles the loganberry in morphology, sex, fertility, and chromosome number. It, like the loganberry, is nearly true breeding. The dominance relationships in these polyploids and sex determination in the Rubi hybrids are interesting. The cytology of *R. vitifolius*, loganberry and diploid and tetraploid raspberries indicates that the Hailshamberry and Everbearing are autotetraploid raspberries $iiii$, *R. vitifolius* is an allooctoploid $v_1v_1v_1v_1v_2v_2v_2v_2$. The hybrid between *R. vitifolius* and Hailshamberry has completely paired chromosomes and has the chromosome constitution $v_1v_1v_1v_1\,ii$, which is also believed to be that of the loganberry. Further cytological evidence indicates that the chromosome sets v_1v_2 and i are related to one another, but differentiation has taken place in the different species.

An Electromagnetic Microbarograph

To see whether microseisms might be caused by microbarographic oscillations of similar period, electromagnetic microbarographs have been set up at St. Louis and Florissant (*Trans. Amer. Geophys. Union*, 1938). The instruments were built by W. F. Sprengnether of St. Louis with the collaboration of D. C. Bradford and Father Vincent M. O'Flaherty. One consisted essentially of a large brass air chamber (*ca.* 18·3 litres), over the open end of which was tightly stretched and clamped a rubber diaphragm. The drum stood on its side so that the plane of the diaphragm was vertical. A short solenoid was attached to the diaphragm at its centre with its axis normal to the rubber surface and its weight supported from the frame by two vertical wires balanced by pairs of rubber stays below, spaced at angles of 120° each and stretched parallel to the diaphragm. Into the air core of the solenoid was inserted without contact one pole of a cobalt steel bar magnet rigidly supported by the frame. The air chamber was provided with an adjustable needle valve so that the pressure within the chamber slowly adjusted itself at any predetermined rate to the average atmospheric pressure outside. It was found that a Leeds and Northrup type *R* galvanometer of seven seconds period gave the best registration. The galvanometer magnified the membrane vibrations about 6,600 times. The galvanometer and microbarograph coil were shielded from stray fields. Odd recordings were found to be due to the instrument behaving as a seismograph for very short period vibrations. Blasts and nearby earthquakes have been recorded by the microbarograph when the vibrations of the ground had more or less the same period as the natural vibration of the membrane (*ca.* 0·1 sec.). Distant earthquakes do not affect the microbarograph. The instrument has worked extremely well.

Interior of the Earth

R. STONELEY has published a paper in which he gives a short summary of the various lines of research that supply information on the interior of the earth (*Occas. Notes Roy. Astro. Soc.*, No. 8 ; March 1940). Wiechert's hypothesis that meteorites may be typical of the matter, considered from the chemical point of view, of which the planets are composed, suggested from the classification of meteorites into stony and metallic that rock and iron would be the chief constituents of the earth. On these grounds he proposed a core of specific gravity 8·2 and of radius 0·78 times that of the earth, surrounded by a shell of which the material had a density 3·2. Observations of variation of latitude, earth tides and horizontal pendulums supply important evidence regarding the interior of the earth, and a brief explanation is given of the application of these methods. The well-known h and k terms in the equilibrium tide cannot be derived by observation from the yielding of the earth, but k can be derived from the observations of the variation of latitude. Knowing the value of $1 - h + k$, h can be found, and as these quantities can be obtained by an independent method on the assumption of a certain constitution of the earth, a comparison can be made. Sir George Darwin deduced in this way a rigidity for the earth comparable with steel, assuming a homogeneous composition. The greater portion of the paper is occupied with a description of the evidence obtained from earthquake records. The primary and secondary phases of the preliminary tremors, denoted by P and S, have been identified with the arrival of compressional and distortional waves that have passed through the body of the earth, the times of travel being approximately 1 to 1·8. The behaviour of these waves for epicentral distances greater than 105° led Oldham in 1906 to suggest that the earth had a core of small or zero rigidity incapable of transmitting distortional waves. The subsequent work of Knott, Gutenburg, Wiechert and Jeffreys on the nature of this central core is briefly dealt with. Among other matters considered in the paper are the electrical conductivity in the interior of the earth and the distribution of the internal temperature ; this attains about 3,000° C. at a depth of 550 km., according to Jeffreys.

Adsorption at a Liquid Interface

IT has been shown by experiment that the adsorption at a gas-liquid interface does not always agree with that calculated from Gibbs's equation $\Gamma = -c(d\sigma/dc)/RT$. C. W. Gibby and C. Argument (*J. Chem. Soc.*, 596 ; 1940) have measured the adsorptions of five dyes (methylene blue, Congo red, Bordeaux extra, indigo carmine X and Solway ultra blue B) at a mercury-water interface. The last two include types of structure (indigoid and anthraquinonoid) not previously studied. In each case it was found that the measured adsorption passes through a maximum as the dye concentration increases and is always positive in the concentration range examined. The areas of interface per molecule adsorbed were calculated, together with the approximate areas of the molecules. The ratios of the two sets of values suggest considerable orientation of the molecules at the interfaces. Interfacial tension measurements were made and from them values of the adsorption calculated by Gibbs's equation. These are not in agreement with the measured values and in some cases are negative. In no case do the curves representing theoretical and measured adsorptions coincide at small concentrations.

Use of Eros to determine the Solar Parallax

THE Astronomer Royal has discussed the programme of observations of Eros near the favourable opposition of 1931 (*Mon. Not. Roy. Astro. Soc.*, **100**, 6 ; April 1940). Observations made at Bergedorf Observatory published recently by Dr. C. Vick (*Ast. Abh. Hamburger Sternwarte in Bergedorf*, **5**, No. 3, 1939) led him to conclude that Eros is unsuitable for the accurate determination of the solar parallax. Vick's conclusions are not corrobated by Dr. Spencer Jones. The short-period variations with periods 12·5311 minutes and 79·6845 minutes found by Vick are shown to be non-existent, and the explanation of the large probable errors of some of the Bergedorf observations is found in the unsatisfactory method of observation. Although these suspected short-period variations in the position of the centre of brightness of Eros are not confirmed, other apparent variations in position of the centroid of brightness with periods 5h. 16m. and 2h. 38m. are next investigated. Eros is known to be variable in brightness with a total period of 5h. 16m., and the period between consecutive minima of brightness is 2h. 38m. In the discussion of the 1901 observations, Hinks did not obtain conclusive evidence of such variations, from which it may be inferred that the effect must be small. The present investigation failed to detect any variation with period 5h. 16m., nor could any variation with period 2h. 38m. be detected in right ascensions. There is a small but well-confirmed displacement in declination with a period 2h. 38m., of total range about 0·05″. As this variation has no systematic effect on the determination of the solar parallax from the comparison between the observations in declination at northern and southern observatories, the conclusion is that Eros is a suitable object for the accurate determination of the solar parallax.

SOME ASPECTS OF AMERICAN CONSERVATION SCHEMES*

ROLE OF RECLAMATION IN CONSERVATION

BY JOHN C. PAGE, BUREAU OF RECLAMATION

THE biggest job for conservationists is to combat the habit of thinking in terms of limitless resources. The destructive results of this habit, seen in our dwindling forests, our abandoned mines, and our gullied fields, have not yet caused sufficient impression to turn us completely away from our foolish optimism as to the future.

The movement towards conservation, begun under Theodore Roosevelt four decades ago with the establishment of the National Forest Service and the Bureau of Reclamation, has received its greatest impetus under President Franklin Roosevelt. Mr. Harold L. Ickes, of the Department of the Interior, defines conservation as 'prudent use'. This is the sense of the word in which the Bureau of Reclamation has tried to carry forward its own particular field of conservation—irrigation in the West. One third of the United States—the West—is arid or semi-arid. Much of this third is desert. Streams periodically drop to tricklets in the dry summer. No agriculture is safe in this West without irrigation, and even irrigation is unsafe without storage reservoirs.

Irrigation in the West is old, was practised before the coming of white men, who took up and improved on Indian methods and thus founded their first settlements. Now twenty million acres have been brought under irrigation, through individual enterprise, co-operative endeavour, and State and Federal aid. Increasing size and complexity of irrigation works have thrust the Federal Government into the position of being the principal agent in the field of water conservation and desert land improvement.

Beneficiaries of this work, carried out by the Bureau of Reclamation, pay its cost. Out of concession to national benefits, the irrigators are not charged interest, but other beneficiaries, such as consumers of electric power, are.

The carefully thought-out conservation work of the Bureau of Reclamation contrasts with earlier methods of developing the West, to which part of our present difficulties are directly traceable. Once western land was regarded as merely a source of revenue. Later, 160 acres was arbitrarily selected as the proper homestead for a family. Still later, it was recognized that irrigation alone would provide the necessary security in most western areas.

With the exception of the Bureau of Reclamation, which plans conservation controls on water and land in advance of their use and development, conservation activity to-day is mainly corrective. The constructive work of the Bureau has resulted in 53,000 new farms, 258 new cities and towns where nearly 1,000,000 people live.

One fifth of the cost of Federal Reclamation projects has been repaid. The projects turn 100,000,000 dollars yearly into the channels of trade. The present programme will ultimately provide 850,000 people with homes.

The future of reclamation is limited by the West's water supply. Its horizon is placed at 42½ million acres, about 6½ per cent of the 700,000,000 arid and semi-arid acres in the West. Twenty million are already under irrigation, and 2½ million are in the Bureau's present construction programme, leaving but 20 million available.

CONSERVATION OF FOREST RESOURCES

BY C. L. FORSLING, U.S. FOREST SERVICE

Forests in great variety originally covered 7½ million square miles, or one half of the land surface of the Western Hemisphere. The area has been reduced to about 6 million square miles since the beginning of the sixteenth century. Growth of population and industries since the middle of the nineteenth century resulted in serious inroads into this rich heritage, especially in the United States, where the deliberate policy of the Government was to transfer ownership of the natural resources into private hands.

The forests of the United States and Canada, owing to their composition and the character of their principal woods, were cut heavily to supply world markets and to meet the needs of growing local populations. Extensive devastation and severe deterioration of the remaining forests resulted. A major problem now is the rehabilitation of these forests to restore them more nearly to their potential continuous productive capacity, which, for the most part, will be a slow process. Meanwhile, demands on the forests of the other American countries will probably increase. Unless steps are taken to prevent it, exploitation of these forests is likely to result in unnecessary destruction or impairment of their productivity, with economic and social effects at least as disastrous as in North America.

The experience of the United States suggests the following essential foundations for a sound policy of forest conservation and use:

(1) Systematic land-use planning to determine, in relation to other forms of land use and social and economic requirements, the amount and character of the available land resource that should be devoted to forestry.

(2) The formulation of policy as to the kind and extent of forest land that should be in public ownership and under public management.

(3) The determination of the means whereby the public may aid in keeping privately owned forest lands productive, and of the degree of public control needed to be exercised over privately owned forest land in order to safeguard the public interest in these resources.

(4) Broad education of people in general and forest owners in particular, as to the value of forests and the basic principles of a forest policy.

(5) A broader knowledge of suitable technique for harvesting and processing forest products, in order to minimize waste, enable efficient operation, and bring the highest sustained income in the long run.

---

* From papers presented at the Eighth American Scientific Congress meeting at Washington during May 1940.

(6) A broader knowledge of the science and practice of forest management and the underlying sciences, with adequate provision for research in these and related subjects, including better protection from fire, insects, and disease.

(7) Development of uses and markets for all manner of forest products, including research on the properties and utilization of wood and other forest products.

(8) Competent, adequately trained forestry personnel.

(9) A minimum of political interference with forestry personnel and policies.

Co-operation of all American countries is needed in order to advance the science and practice of forestry in the Americas; a Pan-American forestry institute is suggested for this purpose.

NATIONAL PARKS IN CONSERVATION

BY ARNO B. CAMMERER, DIRECTOR, NATIONAL PARK SERVICE

The national park idea originated in the New World. In 1870, a party exploring the Yellowstone decided not to try to claim parts of the area for private exploitation but to work for its preservation as a national park to be preserved and enjoyed by the public for all time. Yellowstone, established in 1872, was, therefore, the first national park.

In 1906, the Antiquities Act recognized archæological material on public lands as public property and authorized the President to establish publicly-owned objects of prehistoric, historic, and scientific interest as national monuments, to be preserved intact. In 1916, Congress established the National Park Service to protect the national parks, monuments and similar recreational reservations and to promote their appropriate public use.

In 1933, all national parks, monuments and related historic sites were brought together under the jurisdiction of the National Park Service. In 1935, the Historic Sites Act enunciated the national policy to preserve historic sites and objects for public inspiration and benefit. In 1936, Congress authorized the National Park Service, in co-operation with other Federal agencies and with the States, to conduct a national recreational area study for the purpose of providing a co-ordinated national recreational programme.

The national park system now includes 158 historic and natural areas, totalling 21,515,000 acres. Recreational utility is the yardstick of good land management. Parks are a form of land use—not a type of scenery. The park type of use is equally applicable to the mountain tops, the great plains, the coastal forests, the deserts, or the seashores. Park standards refer to the type of reservation and not to the type of scenery included in it. In parks we attempt to preserve the land whole. To do so our management must rest upon a sound, scientific basis. Parks are for people to use, but we should not confuse the purposes of the wilderness park with the purposes of the city park. Each has its legitimate purposes and should be developed to achieve those purposes.

How many parks are needed? The answer cannot be given quantitatively because recreation is a quality of living. There would be more parks if it were not for the vain promises of the multiple use advocates. Multiple use is the theory that lands can be most profitably managed if used in a number of different ways simultaneously. Multiplicity, however, is not and cannot be an objective. Parks and recreational areas may provide multiple use, but multiplicity is merely an incidental phase of good land management. Multiple use as a descriptive term is not objectionable provided it is merely descriptive of that which is an incidental aspect of optimum use. The multiple use theory has been confused with sound land classification. It is believed that the exponents of multiple use really have optimum use in mind. The classification of resources for their best use would result in more adequate recognition of park and recreational lands.

RANGE CONSERVATION

BY R. H. RUTLEDGE, DIRECTOR, GRAZING SERVICE

In the aftermath of the War of 1914-18, expansion followed by drought, depression, dust storms and shifting populations, America began seriously to take stock of her natural resources. The inventory revealed that a sizable part of our economic and social problems were traceable to a dwindling of range resources. Among other things the evidence led to the conclusion that to ensure the foundation for a desirable standard of living in the range country and in the nation generally there must be an adequate area of forage-producing land and a range conservation programme designed to foster its continued productivity. To secure such a programme Congress passed a number of conservation Acts and placed the conduct and co-ordination of that programme in several Federal agencies. Through the guidance of the Federal Government and the co-operation of States and the citizens range conservation is going forward on a wide front.

The Western range country comprises about half of the total area of the United States. It consists of 11 far-western States and sizable portions of the 6 adjacent plains States. Its gross area of about 1,525,000 square miles is slightly greater than the total of Bolivia, Chile, Colombia and Ecuador, and its grazable land, containing about 1,137,000 square miles, is comparable to the area of the Argentine.

Three-fourths of the wool and mohair, half of the lamb and mutton and nearly one third of the beef and veal consumed in the United States is produced in the western range area. Nearly half of the land is in private ownership; the remainder is public land belonging to States, counties and the Federal Government. Collectively these lands comprise the nation's most important watersheds, and within their borders are found practically all of this country's irrigation projects.

Practically all the development and settlement of this vast area has occurred within the past seventy-five years. In a growing nation possessing seemingly unlimited resources there was no guidance, no general plan to assist the citizens in its development. It was inevitable, therefore, that under existing trial and error methods many mistakes occurred. In this area of variable climate, precipitation, altitude and soil texture there is a delicate balance between plant growth and these factors. There is likewise a delicate balance between plant growth and factors of land use.

Livestock numbers are limited to the safe carrying capacity of the land by the issue of licences and permits to resident users of the range. Studies are made to determine proper seasons of range use, the class or classes of livestock that can use the range most beneficially, and the feasibility of withdrawing from use certain areas to effect rehabilitation by both artificial and natural means.

The problem of range management involves a study of the relationship between private and public land and the devising of plans to make the use of all the lands compatible with the available resources and the economic structure. Range improvements consisting of water development, re-seeding, erosion control works, trails and other facilities, and the elimination of undesirable elements such as rodents, predators and poisonous plants are included in the programme.

Units to facilitate particular administrative objectives and to localize problems in conformity with community and region welfare assure a broad attack on social and economic, as well as physical fronts. By this means the programme is enabled to outline and develop a type of land use that, in the end, will ensure the stability of the unit involved. In turn, this unit, whether it be a grazing district, a national forest, an Indian reservation, a game range, or any suitable allotment or portion thereof, will reflect the benefits derived on the public welfare generally.

LAND UTILIZATION AND FISH CONSERVATION

BY ELMER HIGGINS, BUREAU OF FISHERIES

Land utilization and water utilization are closely related. Water utilization affects aquatic life through changes in habitat. No other group of vertebrates is so delicately adjusted to environment as are fishes. Sudden changes in the nature of environment afford the fishes no opportunity to escape, and death is the only alternative.

Land uses and abuses that have contributed to the diminution of our resources in fresh-water and anadromous fishes, including the effects of agriculture and lumbering, mining operations, petroleum extraction, manufacturing, and the development of urban life and recreational areas are all important. Land restoration practices that do not conserve fish-life include irrigation, power development, canalization of streams, and the draining of sub-marginal lands. Land restoration practices that aid in fish conservation or can be adapted to conservation objectives include erosion control, flood control, pollution abatement, and properly designed water impoundments.

The diversity of interests in land and water utilization demands the development of a co-ordinated conservation programme, particularly with respect to water conservation. The objectives of such a programme may be summed up as follows: The adoption of general principles of water conservation will aid in fishery conservation if the requirements of aquatic life are taken into account when water utilization projects are being planned. In general, the water should be kept on the land, rapid run-off retarded, flood waters stored, erosion prevented, pollution prohibited, canalization of streams minimized, irrigation canals screened, impoundments operated with minimum fluctuation of water-level, dams constructed with outlets at base to improve circulation in reservoirs and provided with fishways where important runs of fishes are obstructed.

SOCIAL STATISTICS OF MERSEYSIDE

THE "New Handbook of Social Statistics relating to Merseyside" prepared by the Statistics Division, Social Science Department, the University of Liverpool (University Press of Liverpool, 1940. 1*s*. net), gives a statistical statement of the position on Merseyside in relation to trade, employment and other social conditions immediately before the outbreak of war. The sections on elementary education and housing have been omitted and rather more material is included relating to the changing state of employment. The first section on the trend of births, deaths and population directs attention to the continuous and steep fall in the birth-rate until the last few years, the level reached in 1938 being about two thirds of that recorded in the 1911–15 quinquennium. The trends of the general death-rate and infant mortality-rate show no evidence of great scope for a further reduction of the general death-rate, and infant mortality is unlikely to decline at the rate experienced in the earlier years of the century. In each of the four boroughs there appears to have been a more or less stable position by 1938, with even a slight tendency to a natural increase in population.

Figures given for the trade of the Port of Liverpool in comparison with that of London, Hull, Southampton and Manchester show that between 1932 and 1938 import values rose by 30 per cent in both London and Liverpool, while export values increased by 50 per cent in London but only by 24 per cent in Liverpool. Articles wholly or mainly manufactured account for £120 millions out of £139 millions exported from Liverpool in 1938, but represent only about one eighth of the goods entering Liverpool. In regard to imports of foods, certain foods touched their lowest point in 1935–37, afterwards rising to about two thirds of their value in 1927–29, whereas the value of every imported raw material listed was higher in 1935–37 than in 1930–32, generally receding again slightly in 1938.

Since 1927–29, the number of insured persons on Merseyside has increased from 362,000 to 424,000, while the number of unemployed rose from 57,000 in 1930 to the 100,000 level in 1935, declining to 80,000 by the middle of 1939. The tables indicate a decline in shipping and shipbuilding over the last ten years and in transport and distribution since 1932, with expansion in metals and engineering and in general service. Shipping and shipbuilding, transport and distribution, now account for only 41 per cent of the total of insured workers as against one half ten years ago. General service, however, has increased from 12 per cent in 1929 to nearly 18 per cent. Taking all industries, the number of insured workers employed in 1939 was 12 per cent above the 1929 level on Merseyside and 18 per cent above that level in the country as a whole. With regard to unemployment, while in comparison with 1932 all industrial groups show decreases in the percentage of insured workers unemployed, varying from 22 in transport and distribution to 67 in metals and engineering, Merseyside shortly before the War had still a percentage of unemployment of 18·8 as against 9·6 in Great Britain and Northern Ireland as a whole.

Analysis of the unemployment situation indicates that out of nearly 80,000 unemployed, 35,000 may be regarded as normal, 8,400 must be attributed to the abnormal times from which all parts of the country have suffered, and 36,000 to the exceptional character of Merseyside. One half of the normal unemployment on Merseyside is accounted for by the shipping, shipbuilding and related industries, where a high proportion of the total is made up of dockers and other casual workers. The general rise in unemployment among women since February 1939, while unemployment generally had decreased by nearly 24,000 (February 1940), is attributed to the much greater transfer of men to the heavy industries and to other war-time production and to the services. The number of unemployed clerks, typists and bookkeepers increased from 592 in 1939 to 2,731 in 1940, due to the closing down or contraction of businesses engaged in the manufacture or distribution of commodities not essential for life and a moderate degree of comfort and for the prosecution of the War. Unemployed boys between 14 and 17 years of age decreased by 22 per cent and girls by 5 per cent when the average of 1939 is compared with 1938, while for boys the February 1940 figure was 18 per cent better than the February 1939 figure, the March figure being 39 per cent better than last year's. For girls the February unemployed total was 57 per cent greater than the 1939 figure, but for March 1940 the figure was only 34 per cent greater than that of March 1939.

For the combined unemployment benefit and unemployment allowances, the expenditure during four weeks in 1939 was £387,544 as against £280,530 in the corresponding weeks in 1940. The total number of persons in receipt of relief in the combined Merseyside boroughs fell from 58,000 in March 1939 to 48,000 in March 1940, with a decline in expenditure from £75,689 to £71,441 for the corresponding four weeks. The local rates have been increased only slightly for 1940–41, increases due to civil defence measures being offset to some extent by savings under 'black-out' regulations.

FISHERIES RESEARCH IN HONG KONG*

IT does not often happen that the official publication of a research station makes its appearance before the erection of the station itself has even begun; and certainly this enterprising inauguration of the *Journal of the Hong Kong Fisheries Research Station* will be most gratifying to those who have persistently advocated and worked for the establishment of fishery science throughout the British Empire. Tribute will be paid to Dr. Herklots, the editor of the *Journal* and honorary director of the Station, whose organizing ability and unbounded enthusiasm inspire confidence in the future of the work at Hong Kong, despite the tremendous difficulties occasioned by wars to which both the British and Chinese peoples are unhappily committed.

Since the primary purpose of the Station is to study the fishes of the South China seas and the fishing techniques employed by the local fishermen with a view to the future benefit of the fishing industry, it is appropriate that the early numbers of the *Journal* should be devoted to a general survey of the Hong Kong fisheries. Dr. Lin makes a good beginning with his detailed and well-illustrated account of the boats, gear and fishing methods. It is the story of a remarkable people who make their permanent homes and live their lives in the fishing junks with their families. Men and women, and girls and boys above the age of fifteen, form the fishing personnel; family life proceeds in specified quarters; and a shrine for worship is always to be found in the heart of the ship.

The junk trawlers, varying from 50 to 90 feet in length, are perhaps the biggest and most important fishing vessels employed in China. It is claimed that there are about a thousand registered in Hong Kong, all operated and many owned by the floating population of Kwangtung and Hong Kong. Save for the smaller forms, all the trawling junks are three-masted wooden vessels with the bow comparatively low and the stern very high. No wheel house is provided and the detachable, heavy rudder is manipulated by means of the tiller on the high stern. Sleeping places for the crew are located below deck in front of, or behind, the main mast; the shrine is always situated in a hold immediately in front of the aft hold. On the stern, several rooms are constructed above the poop to accommodate the owner's family and the galley. Drinking water is kept in holds either on both sides of the main mast or behind it. The fishing gear, ice, salt and the catches are stored in special holds between the main mast and the stern. A long roller for hauling in the trawl is fitted with 8–10 handles and operated by 8–10 members of the crew, and is situated either on the starboard side behind the main mast or transversely in front of it. The anchors are manipulated by capstan. The sails are constructed of mats in preference to canvas; the latter is the better material for sail-making but is too light to be easily lowered or swung from one side to the other with the speed required during fishing operations.

Giving equally interesting details, Dr. Lin goes on to describe beam-trawlers, purse-seine and drag-seine junks, and long-liners. Next he deals with the personnel, varying from 6 to 25 persons per junk, most of whom are hired on a time-wage basis with (sometimes) a bonus on the value of the catch. As most of the fishermen know the whole process of fishing and the different tasks on board are sufficiently straightforward, there is no special allotment of duties, and all interchange freely. Eight types of fishing gear are used, all of which should be of particular interest to students of British fisheries, since there is much to be learned from them which might well prove serviceable in home waters. E. F.

---

*Journal of the Hong Kong Fisheries Research Station. Edited by G. A. C. Herklots, Vol. 1, No. 1, Feb. 1940. Pp. 1–101 with frontispiece, 6 plates and 48 figs. in text. (Hong Kong: The South China Morning Post, Ltd.). 3 dollars.

CAST IRONS IN AUTOMOBILE CONSTRUCTION

DURING the last ten years the progress made in automobile development and production has been due, in very large measure, to improvements in the materials of construction. Of these, cast iron ranks as one of the most important. The great majority of the cars currently purchased in the United Kingdom are of the 'quantity production' class. It is the use of this type of car that is considered by E. C. Toghill and R. V. Dowle in a paper on the "Applications of Cast Iron in Modern Automobile Construction" recently published (*J. Inst. Automobile Eng.*, March 1940).

The object of the paper is to bring to the notice of the automobile engineer and designer some of the irons with special properties for specific applications, and to show that the grading of cast iron and the choice of the correct grade for the purpose are as important as in the case of steels.

The influence of nickel, chromium, molybdenum and copper in cast iron is summarized as follows. In connexion with the use of special elements, the important role of nickel in automobile cast irons is pointed out. Nickel is a graphitizing element, being in this respect about one third as powerful as silicon, but whereas silicon coarsens the grain and the graphite, nickel has a refining effect. In addition, the presence of the nickel renders the iron more uniform and less sensitive to sectional change. A correct balance of nickel and silicon is an important factor in the production of an alloy having the best properties. For example, if no allowance is made for the graphitizing influence of nickel, that is, if no proportionate reduction of the silicon is made, little increase in strength is observed up to about 1·5 per cent of nickel, after which, strength and hardness gradually increase. If, on the other hand, the silicon content is suitably adjusted, additions of 0·5–5 per cent of nickel will give 10–50 per cent increase in tensile strength.

Strength, hardness, depth of chill, and resistance to heat wear and corrosion are increased by the presence of suitable amounts of chromium, and provided that the carbide is not in massive condition, the shock-resisting ability of the iron is also enhanced.

Molybdenum refines the grain of the iron and the graphite, and has a very beneficial effect on shock resistance. Molybdenum stabilizes carbides and increases tensile and transverse strength; it also produces a slight improvement in corrosion- and heat-resistance and in machinability. In many respects, copper produces similar effects to nickel. Tensile and transverse strength are improved by the presence of small amounts of copper, the effect being most pronounced in low carbon irons. Fluidity of cast iron is also improved by the presence of copper.

Messrs. Toghill and Dowle direct attention to the extensive research in progress under the joint auspices of the Institution of Mechanical Engineers and the British Cast Iron Research Association, in which a collation is being made of the range of high-duty cast irons and of their properties and uses in general engineering. The aim of the work is to provide the automobile and other engineering industries with data which will facilitate the choice of the grades of cast iron suitable for widely diverse applications.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GRADUATE IN PURE SCIENCE able to take CHEMISTRY, PHYSICS and MATHEMATICS TO 1ST YEAR DEGREE STANDARD, and a WORKSHOP INSTRUCTOR also capable of taking some MACHINE DRAWING—The Principal, County Technical College, Worksop, Notts (August 15).

CHIEF ASSISTANT ENGINEER to the Port of Bristol Authority—The General Manager, Docks Office, Queen Square, Bristol 1 (August 19).

CHIEF LABORATORY ASSISTANT in the County Bacteriological and Pathological Laboratories—Dr. T. N. V. Potts, County Medical Officer, County Hall, Wakefield (August 19).

EDUCATIONAL PSYCHOLOGIST—The Director of Education, Education Department, Town Hall, Barnsley (August 21).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Association of British Chemical Manufacturers. Directory of British Fine Chemicals produced by Members of the Association. Pp. 80. (London: Association of British Chemical Manufacturers.) Gratis. [187

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 2, No. 14: The Genetical and Mechanical Properties of the Sex Chromosome, vi. *Hexacentrus mundus*. By Dr. P. C. Koller. Pp. 174–181. 9*d*. Vol. 60, Part 2, No. 15: A Theoretical Atomic Distribution Curve for Liquid Argon at 90° K. By G. S. Rushbrooke. Pp. 182–191. 1*s*. Vol. 60, Part 2, No. 16: The Loss of Heat by Conduction from the Earth's Crust in Britain. By Dr. E. M. Anderson. Pp. 192–209. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [267

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 6: The Geology of the Highland Border from Glen Almond to Glen Artney. By Dr. Douglas A. Allen. Pp. 171–193+1 plate+1 map. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4*s*. [267

Prospectus of the London School of Economics and Political Science (University of London) for the Forty-sixth Session, 1940–41. Pp. 146. (Cambridge: London School of Economics and Political Science.) 1*s*. [267

Sheffield City Libraries. Research Bulletin No. 4: Sheet and Strip, Part 2: Sheet and Strip Finishing Processes and Special Sheet Materials. Pp. 22. (Sheffield: Central Library.) 3*d*. [297

Other Countries

Field Museum of Natural History. Botanical Series, Vol. 22, No. 2: Studies of American Plants, 10. By Paul C. Standley. (Publication 472.) Pp. 63–130. (Chicago: Field Museum of Natural History.) 50 cents. [157

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 21, Fasc. 4: Tables des planetes 296, 711, 736. Par le P. E. de la Villemarqué. Pp. 44. (Zi-ka-wei: Observatoire de Zi-ka-wei.) [177

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 132: The Wood Anatomy of some Australian *Lauraceæ* with Methods for their Identification. By H. E. Dadswell and Audrey M. Eckersley. (Division of Forest Products, Technical Paper No. 34.) Pp. 48+8 plates. (Melbourne: Government Printer.) [227

Burma Meteorological Department. Meteorological Organization for Airmen. Pp. iv+33. (Rangoon: Government Printing and Stationery Office.) [227

Agriculture and Animal Husbandry in India, 1937–38. Pp. v+416. (Delhi: Manager of Publications.) 5·14 rupees; 9*s*. 3*d*. [247

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 33: Selected Clinical Articles—1: A Few Cases of Johne's Disease in Sheep, by Muhammad Rahim-Ud-Din; 2: A Case of Pregnancy in the Mammary Gland, by C. D. Uttangi; 3: An Unusual Case of Microfilarial Granuloma on the Prepuce of a Bull, by R. C. Nathani and N. S. Sankaranarayanan. Pp. 10+4 plates. (Delhi: Manager of Publications.) 9 annas: 10*d*. [247

Imperial Council of Agricultural Research. Proceedings of the Third Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India, held at New Delhi from the 20th to the 23rd February 1939, with Appendices. Pp. iii+307. (Simla: Government of India Press.) [247

Canada: Department of Mines and Resources: Mines and Geology Branch, Geological Survey. Paper 40–2: Wildcat Hills Map-Area, East Half, Alberta. By C. O. Hage. Pp. ii+9+1 map. 10 cents. Paper 40–3: Preliminary Map, Michiwacho Lake, Abitibi Territory, Quebec. By H. H. Beach. 1 map. 10 cents. Paper 40–4: Preliminary Map, Mechamego Lake, Abitibi Territory, Quebec. By H. H. Beach. 1 map. 10 cents. Paper 40–5: Preliminary Map, Fish Creek, Alberta. By G. S. Hume. 1 map. 10 cents. Paper 40–7: Preliminary Map, Gordon Lake South, Northwest Territories. By J. F. Henderson. 1 map. 10 cents. Paper 40–9: Preliminary Map. Gordon Lake, Northwest Territories. By J. F. Henderson. 1 map. 10 cents. (Ottawa: King's Printer.) [297

U.S. Department of Agriculture. Circular No. 547: Feeding Habits of the Adult Japanese Beetle. By I. M. Hawley and F. W. Metzger. Pp. 32. (Washington, D.C.: Government Printing Office.) 5 cents. [297

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 17, 1940 No. 3694

PREPARING FOR A NEW WORLD ORDER

THE rapidity with which the march of events has thrown on Great Britain the main and almost the sole burden of the defence of the liberties and traditions of Western civilization, endows with something of prophetic vision the Prime Minister's declaration on June 4 of our determination to continue the struggle : "if necessary, for years, if necessary, alone". Under that burden we can have but one war aim—victory. Inexorably other discussion on war aims has for the time being to be thrust into the background, like the shattered solemn declaration of the Supreme War Council of March 28, with all the hopes it seemed to foreshadow of a new European order based on Anglo-French co-operation.

Such co-operation is for the time being impossible. On us now falls the material burden of staying the onslaught of aggression and barbarism and making safe for mankind those moral and spiritual values to which we owe all that is best in our civilization.

It is well that we should remember, however, that although the material burden is largely ours alone, we have the sympathy and often active support not only of those nations such as Czechoslovakia, Poland, Norway, Holland, Belgium whose liberation waits on the success of our arms, or of the great countries across the Atlantic, but also of many Frenchmen still in France. As regards those Frenchmen who have come to Great Britain, the memorandum of agreement recently made between the British Government and General de Gaulle provides for a French force of volunteers including naval, land and air units and scientific and technical personnel, who will fight and work for the Allied cause ; further, such volunteers will be given special facilities for acquiring British nationality.

None the less, if we are to obtain in due course the full results of our efforts, for our allies and well-wishers as for ourselves, we must turn our attention to the history of the last twenty-five years, to probe the real causes of our failure twenty years ago to build a durable world-order, and to be ready to avoid the mistakes of the past when the opportunity to build again is vouchsafed us. As Sir Herbert Parsons points out in a letter in this issue of NATURE (p. 230), it is not too early to take steps to consider the future in the light of experience of the past two decades.

It is this point of view that gives topical interest to Prof. E. H. Carr's "The Twenty Years' Crisis" and to the more recent volumes of Dr. Maxwell Garnett and Mr. Arthur Bryant referred to below*. Prof. Carr attempts to analyse the underlying and significant, rather than the immediate and personal, causes of the present war, and he opens with a discussion of the science of international politics which should make a direct appeal to the man of science. None the less, the scientific worker who reads with keen appreciation Prof. Carr's opening chapter on the beginnings of the science of international politics, with its insistence on the relation between purpose and thought, its reminder that political thought itself is a form of political action, that political science is the science not only of what is, but of what ought to be, its warning about distinguishing the analysis of what is from aspiration about what should be, may yet put the whole book down with some sense of disappointment. Despite all his keen analysis of particular situations, his historian's impartiality and his shrewd comments, Prof. Carr appears to lead us nowhere. His concluding analysis of the prospects of a new international order lacks conviction and definition and offers little that is constructive.

---

* The Twenty Years' Crisis, 1919–1939 : an Introduction to the Study of International Relations. By Prof. Edward Hallett Carr. Pp. xv+313. (London : Macmillan and Co., Ltd., 1939.) 10*s*. 6*d*. net

A Lasting Peace. By Dr. Maxwell Garnett. With some Chapters on the Basis of German Co-operation, by Dr. H. F. Koeppler. Pp. 288. (London : George Allen and Unwin, Ltd., 1940.) 7*s*. 6*d*. net.

Unfinished Victory. By Arthur Bryant. Pp. xxxvi+271. (London: Macmillan and Co., Ltd., 1940.) 8*s*. 6*d*. net.

The reason for this is easily found. Prof. Carr insists that Utopia and reality are the two facets of political science, and the whole book is largely an essay or commentary on the implications of the opposition between Utopia and reality in the light of the history of the past twenty years. Unfortunately, Prof. Carr does not carry his analysis of political objectives or ideals far enough. The distinction between reality and Utopia is never made clear to the reader. The two common meanings of Utopia are confused, and generally the analysis of terms, events or causes is not pushed far enough. Partly as a result of this, Prof. Carr's obvious desire for strict impartiality leads him to do something less than justice to the attempts to build a new world order, whether through the League of Nations, collective security, federation or the like. The opponents of world co-operation are invariably given the benefit of the doubt, despite a reminder that it is by no means certain that a direct appeal to the motive of sacrifice will always fail.

Prof. Carr, in fact, largely overlooks or underestimates psychological factors, and valuable as his work may be as a corrective to wishful thinking, or as a contribution to putting the factors of power and morality in their proper perspective in international politics, or for its analysis of the relations between law and change, it does not make the significant contribution to the science of international relations which might be hoped from its opening part. It should indeed be read with L. Woolf's stimulating essay "Utopia and Reality" in the *Political Quarterly* (April–June 1940)—itself essentially a thoughtful review of the book. None the less there are few recent books which are more worthy of attention from those who are attempting to think out the lines of the new world order.

Prof. Carr regards the fundamental difficulty of reconciling the good of the nation with the good of the world community as due to the breakdown both of the Darwinian doctrine which identifies the good of the whole with the good of the fittest and contemplates without repugnance the elimination of the unfit, and of the doctrine of a natural harmony of interests which, in his opinion, has lost such foundation in reality as it once had and becomes inevitably a cloak for the vested interests of the privileged. Our task of exploring the ruins of our international order and discovering on what fresh foundations we may hope to rebuild it must be considered from the point of view of power and of morality. The form of the future international order is closely bound up with the future of the group unit, and it may well be that the concept of sovereignty will become even more blurred and indistinct. The best hope of progress towards international conciliation seems to lie along the path of economic reconstruction.

L. Woolf dissents from Prof. Carr's view that the doctrine of harmony of interests has lost its validity. He points out that individuals as well as nations often fail to recognize their real interests, and that generally and in the long run common interests are more real politically than conflicting interests. The real international problem which confronts Europe and civilization to-day is not a choice between Utopia and reality but between the psychology of conflicting interests and the organization of power politics on one hand, and the psychology of common interests and the organization of international co-operation on the other. Woolf, however, is himself too legalistic. The transition to a durable peace and a more equitable social order must be in the sequence order, law and good government, as Sir Alfred Zimmern remarks, not law and then order. "No paper plan," insisted Lord Halifax, in a broadcast last autumn, "will endure that does not freely spring from the will of the people who alone can give it life."

Prof. Carr would doubtless concur that education is one of the essential tasks in the establishment of world order. That question is discussed in two of the most important chapters of Dr. Maxwell Garnett's book. The world commonwealth of the future can only be held together by a world loyalty and the invisible bond of ideals, and the problem of building world order on a lasting basis belongs in the long run no less to psychology and education than to politics and economics.

Dr. Garnett deals with the immediate causes of the present conflict and the breakdown of international co-operation. In some respects his analysis of the history of the last twenty-five years is more realistic than Prof. Carr's. In contrast to the latter's cool detachment, Dr. Garnett does not conceal the fact that he is on the side of the angels. He is concerned, however, to lay bare the causes of the failure of the first experiment at international co-operation and world order through the League, and his survey and criticism cannot be dismissed as one-sided or superficial. The ordinary citizen will find his argument much easier to follow, if in some respects less profound, than that of Prof. Carr, and the book is a notable contribution to the educational work which must proceed, both during the War and after it, before we can achieve a lasting peace.

Dr. Garnett quotes the text of the Solemn Declaration of the Supreme War Council of March 28 and obviously visualizes the gradual development of the new international order out of that Anglo-French co-operation. Nor need we fear that the act of one French Government need compel the abandonment of all hope that that co-operation may yet prove the stepping-stone to such a new order when the menace of aggression and barbarism has been removed.

This factor gives special significance to the last part of the book, in which Dr. H. F. Koeppler, under the title "The Basis of German Co-operation", gives a succinct review of German history, particularly the unification of Germany, and discusses its bearing, as well as that of the rise of Nazism, on the establishment of a lasting peace. It is here, as in its stress on the importance of education, that the book touches common ground with Mr. Bryant's "Unfinished Victory", the finest in quality and most moving of the three. Writing with all the impartiality of the historian, Mr. Bryant gives us a study of Germany history from 1916 and an interpretation of Hitler and Nazism which can scarcely fail to facilitate the creation of an understanding between the British people and the Reich when the War has come to an end. The heart of the book is in the introductory "Historian's Testament", with its hope that the book may help in the right use of victory when it has been won for us by the valour and endurance of our race.

Mr. Bryant's sincerity and balance can scarcely fail of their purpose to make it a little easier for the people of Great Britain to understand the causes of the violence and aggression of our enemy, and as he points out, we can only achieve our end of freeing Europe from the effects of that violence and aggression when we have reached that understanding. But few who read the book will fail to be grateful also for the interpretation of the national spirit given in a passage written after the march to Prague. There is in these pages a quality of the spirit which is the surest token that victory won once again will this time not be unfinished or in vain.

These books are permanent evidence that in the midst of this struggle there are those who, recognizing all that it demands of us, are looking to what lies beyond. The reader may well find in their pages, not vain visions or castles in the air, but the quality of mind which will strengthen him to endure all that may be asked of him in the ordeal that lies immediately ahead ; and, when victory is won, to play his part in the travail out of which the new world order will be born. The three books together make no mean contribution to fundamental thinking on the enduring values of Western civilization for which we contend, and on their enthronement in a new order, social as well as international, from which, not change or evolution, but war has been eliminated. Such thought running ahead of realization, as A. N. Whitehead reminds us, is the condition of quick transition to new types of civilization. That it should proceed in the midst of so stern a struggle as that in which we are now engaged may indeed be the earnest of final victory.

ARE WE ALONE IN THE UNIVERSE?

Life on Other Worlds
By Dr. H. Spencer Jones. Pp. xiv+259+17 plates. (London: English Universities Press, Ltd., 1940.) 7*s*. 6*d*. net.

As every professional astronomer knows, there is a vast population of laymen for whom the really exciting problems of astronomy are not those associated with the finiteness or supposed expansion of space, or the sources of stellar energy, but with the canals on Mars and the possibility of life on Mars. In this little book of 250 pages, the Astronomer Royal tells us of the findings of modern astronomy on these latter questions, and much besides, in a way that will not only interest the layman, but the professional scientist as well. It is a model of what such a book should be, popular and scientific at the same time, clear but concise in its writing, with the main theme standing out unburdened by irrelevant details, and the conclusions stated with balance and fairness. If there are any inaccuracies of fact, or even of typography, the present writer has failed to notice them.

Yet the book is something more than a mere exposition of the accepted findings of modern astronomy; here and there the author adduces new arguments, and opens up new vistas of thought. These deserve the compliment of critical examination.

After giving us a thumb-nail "picture of the universe", the author explains why living matter on earth consists largely of compounds of carbon, and why it must probably do so wherever it appears. Life would thus seem to be restricted to a very narrow range of temperature, and this, in conjunction with other quite simple considerations, rules out all planets except the earth and Mars as possible abodes of life. The chapter on Mars, then, must contain the core of the discussion, and its title, "Mars—the Planet of Spent Life", informs us of its conclusions in advance.

We read first of Schiaparelli's discovery of the "canali" on Mars, and of Lowell's attempt to interpret them—in opposition to Schiaparelli's considered opinion—as canals built by intelligent beings to transport water, by a pumping system of 4,000 times the power of Niagara, from polar ice-caps to the equatorial regions. Dr. Spencer Jones rejects this interpretation *in toto*, and indeed he could do nothing else. For the supposed ice-caps are probably not ice at all, but clouds; and even if they were of ice, they could not be more than a few inches thick, otherwise they would not melt away and disappear, as they do, in the chilly Martian summer. Further, while the camera shows that some at least of the "canali" have a true objective existence, it shows them as rows of broken smudges rather than as continuous canal-like structures. Now it is known that the eye, straining to study such a row of dots or smudges in a poor light, will subjectively connect them up into a straight line; Greenwich schoolchildren, when told to copy a badly-lighted map of Mars, not only inserted the features that were on the map. but also systems of "canals" that were not there. Lowell saw many of the supposed canals doubled at distances of about 0·26″, although the resolving power of his telescope was limited to 1·0″. All this makes it clear that the problem must be attacked along other lines.

Mars is commonly supposed to have been formed from the outer layers of the sun, in which free oxygen is abundant, yet the spectroscope shows no trace of free oxygen in the Martian atmosphere. It is reasonable to suppose that the original oxygen has combined with other elements, Mars looks red, and many oxides are red, so that we may conjecture with Dr. Spencer Jones and many others that "Mars may be a planet where the weathering of the rocks, followed by their oxidation, has resulted in the almost complete depletion of oxygen from the atmosphere". But it is surely going too far to say that "the colour of the surface of Mars provides sure evidence of the presence of free oxygen, at any rate in the past", and still more so to continue, "The presence of free oxygen almost certainly demands the existence of vegetation". Surely the observations are most simply explained by supposing that the free oxygen which came from the sun has all, or nearly all, been absorbed by the rocks; the question of vegetation does not come in at all, except that if there were abundant vegetation, we should expect to find abundant free oxygen in the atmosphere, which we emphatically do not.

The author finds a further argument for the existence of vegetation in the seasonal colour-changes which occur on the surface of Mars, certain areas turning dark green, or at any rate dark, in the summer. Here he is again in company with many other astronomers. He rejects Arrhenius's suggestion that the areas in question may be covered with soluble or hygroscopic salts which change colour in rainy weather. He might have added that Lyot's recent careful studies of the reflecting and polarizing qualities of the surface of Mars seem to indicate that this consists of volcanic ash—like the moon.

Beyond the solar system the question of the existence of life becomes a matter for speculation controlled only vaguely by theory. If we are right in believing that planetary systems can only come into existence through the close meeting of two stars, then only a minute proportion of the stars can be accompanied by planets. Even so, there are so many stars in space that the total of planets must be large, and many of these must be in a condition to support life—if it comes. But will it come? Dr. Spencer Jones gives us little help here, telling us, on the first page of his preface, that he assumes life will come whenever the conditions are favourable; others may prefer to make the opposite assumption. Here is the question which, because of its philosophical and religious implications, interests the layman most, and the astronomer as such can give him but little guidance. We know of two, or at most three, planets on which the conditions are suitable for life. The earth falls out of any statistical discussion, because we should not be discussing the problem if life had not come to it. Venus is almost certainly too hot—and Mars? Clearly there is not yet adequate material for statistical discussion.

J. H. JEANS.

FRUITS OF THE RENAISSANCE IN ARCHÆOLOGY

The Prehistoric Foundations of Europe to the Mycenean Age
By C. F. C. Hawkes. Pp. xiv + 414 + 12 plates. (London: Methuen and Co., Ltd., 1940.) 21s. net.

THE past twenty years have seen an astonishing development in a broad field of historical study of which natural scientists have often been more aware than the majority of historians. Even the bare outlines of human history in Europe for more than nine-tenths of the total period of human occupation could not be indicated in 1920. The fruits of intensive work in prehistoric archæology at a multitude of sites revealing cultures separated in time by hundreds of thousands of years may to-day be co-ordinated securely enough, not merely to establish the outstanding phases of the culture history of Europe down to Classical times, but also to point with confidence to many of the physical and sociological conditions involved in the series of technical revolutions, migrations and territorial consolidations which occurred. The natural scientists have become acquainted with these remarkable achievements because their co-operation has been successfully sought in attacking a multitude of technical problems on which the delineation of this complex field of culture history has depended. To the anatomists and physical anthropologists have been referred problems of racial evidence for connexion and migration; the palæobotanists and geologists have provided techniques for the construction of prehistoric time scales, and have in their turn been aided by the archæologists, who have provided type fossils for their own problems of zoning. Mineralogists and chemists have made vital contributions to problems concerning the conditions and scenes of the decisive metallurgical and other technical advances of prehistoric times.

Mr. Hawkes's masterly survey of the greater part of this vast prehistoric field, the cultural development in Europe from the time of the first palæolithic occupants to the establishment of the 'cultural balance' of the Middle Bronze Age in the second millennium B.C., is from this point of view a repayment for these many contributions from the natural sciences, contributions the significance and importance of which are made clear in the course of his complex narrative.

The renaissance of European prehistory in Great Britain may be said to date from the publication of Crawford's "Man and His Past" (1921) and the first edition of Childe's "Dawn of European Civilisation" (1925). Before this prehistoric archæology was still very largely the grubby handmaiden of the conventional historian, the folklorist and the evolutionary technologist. Archæological data were too often conceived as useful merely for buttressing or refuting historical hypotheses based on literary records, legends or *a priori* theories of social and technological development. Flintwork and pottery, celts and swords were usually regarded only as the alleged, and often inadequately alleged, products of dimly conceived 'races' or stages of human development. The revolution in outlook consisted essentially in attempting to build up by every means possible without reference to preconceived theories of origin, as full a picture as possible of the culture, time point and physical environment of the society whose members had used the artefacts discovered by chance or excavation. The amazing measure of success which has been achieved and the multitude of painstaking investigations which have contributed to the pictures Mr. Hawkes is able to present will be immediately clear to the reader of his book.

Archæology once obsessed by relics of lost 'races', by intimations of the 'pagan rites' of our 'ancestors', is now moving towards a position in which the historical geography, the sociology, economies and the religious systems of the human race may be adequately sketched from the ultimate dawn of history, the emergence of man. In the first phase of this advance there was a marked emphasis on environmental control of prehistoric cultures; later, under the stimulus of Prof. Childe's brilliant analyses, the economic revolutions of prehistoric times and their technological bases have formed the framework for classification and narrative. One of Mr. Hawkes's major contributions is to bring back into focus the sociological implications of culture contacts and in particular the rise and expansion of dominant groups and of their ritual systems. Some earlier studies have too often left one with an impression of prehistoric groups as pawns of the European forests and loess; the emphasis on economic forces, while never deterministic, has also on occasion obscured the fact that a society is never merely an economic organization, that social values other than immediate economic advantage may be spurs to cultural change and, in particular, that there are indications of the effects of mystic zeal and the potency of religious symbolism in the culture spreads of prehistoric Europe. In his treatment of both the

Ægean cultures, of the role of the 'megalithic religion' in Atlantic lands and of the cultural unification imposed by the Warrior peoples of Central Europe, to cite but a few examples, Mr. Hawkes has restored the balance. He formulates hypotheses of social organization for every adequately documented culture and, while some may have to be revised in the future, the foundations of the social history of prehistoric Europe have been soundly laid.

In its plan and general organization this study follows broad lines which will be familiar to students of European prehistory. It is remarkable not only for the balanced and catholic treatment of the main trends, but also for the wealth of detail which Mr. Hawkes, revealing extraordinary command of the vast and scattered literature, has contrived to incorporate in his narrative. Making use of every stylistic device for compression he has been able to illustrate and discuss in some detail every cultural phase and problem. Nor is this only a compendium of current views; quite often, as, for example, on the source of the Danish 'dolmens', on the introduction of cremation rites in northern Ireland and in disentangling the complexities of the ceramic tradition in Early Bronze Age Central Europe, new approaches and hypotheses are offered. It must be admitted that the compressed and parenthetic style make considerable demands on the reader's attention; but his patience is rewarded by a full and critical treatment in extraordinarily small compass. The plates and assemblages of line drawings have been selected with great skill, and admirably document the text; but the maps are less successful.

DARYLL FORDE.

GEOLOGICAL HISTORY AND MINERAL RESOURCES OF SOUTH AFRICA

The Geology of South Africa

By Dr. Alex. L. du Toit. Second edition, revised and enlarged. Pp. xii+527+41 plates. (Edinburgh and London: Oliver and Boyd, 1939.) 28*s*. net.

SOUTH AFRICA, paradise of geologists, continues to bring forth its treasures. For many generations it has supplied the world with gold, diamonds, platinum and corundum, while in recent years the development of its resources in other essential minerals, such as tin and tungsten, has become increasingly important. In the realm of palæontology, it has furnished, from the rocks of the Karroo System, a wealth of well-preserved material for evolutionary studies in early reptiles, amphibians and fishes. Archæologists, too, have looked upon this region as a happy hunting ground, for within the last few decades it has yielded skeletal remains of early man and anthropoid apes, as well as a large series of primitive stone implements.

From the moment the visitor to South Africa sights Table Mountain his eye is arrested and his imagination fired by the peculiar and distinctive scenic types of the country; he is held in wonder by the kopje landscapes, the great cliff of the Drakensberg, the desert wastes of the Kalahari, the granite weathering of the Matoppos, and the mysterious Great Dyke of Rhodesia. The geological pilgrim especially is impressed by the knowledge that, on not less than five (and possibly even more) occasions the country has undergone the vicissitudes of Ice Ages, all of great antiquity, occurring in pre-Cambrian, Cambrian (?), Devonian, and Carboniferous times. In some of these periods the area may have been near the periphery of the great ice-sheets, so that it received only scratched pebbles and erratics dropped from melting icebergs or ice-sheets, but in late Carboniferous times, when the world-famous Dwyka deposits were formed, there was evidently a widespread glaciation that radiated westwards and southwards from the region that is now the Transvaal. The Dwyka deposits show beautifully preserved examples of glacial floors, pavements, roches moutonnées, disturbance, striæ, chatter-marks, varve-like clays and the like. So remarkable, indeed, are these phenomena, that the Union Government has wisely decreed that the Nooitgedacht Farm area, where they are exceptionally well exposed, shall be established as a natural reserve, just as the Glacier Garden of Lucerne is preserved as a testimony of the much more recent Pleistocene glaciation. (Curiously, Nooitgedacht has escaped mention in the index.)

These and many other equally interesting subjects are discussed in Dr. du Toit's book, now the standard work on the "Geology of South Africa". The volume appeared in its first edition in 1926 (reviewed in NATURE of May 7, 1927). In the second edition, the work has been revised throughout and, in consequence, somewhat enlarged. The accompanying coloured geological map has been corrected and brought up to date; it includes

Southern but not Northern Rhodesia. Among the chapters that have been expanded are notably those dealing with the Witwatersrand gold-mining area, the economic resources of South Africa, the Ventersdorp volcanic series and the petrology and tectonics of the Vredefort Dome.

The results of recent geological investigations have been incorporated, as, for example, in the revised classification and subdivision of the "Primitive" or oldest Pre-Cambrian rocks, and in the account of the characters and distribution of the Nama System, a rock-group assigned to the Cambrian or latest pre-Cambrian on the evidence of its fossils, which appear to have affinities with the Archæocyathidæ, sponges and stromatoporoids. Similarly, in his account of the Vredefort "Dome" of granite, an extraordinary mushroom-shaped structure "of truly amazing character", the author has summarized the later work of Molengraaff and Hall, and of S. J. Shand.

The problem of the mode of origin of the gold emplacements in the Rand conglomerates (or bankets) is discussed at length, and, notwithstanding the recent attacks of Graton and others on the placer theory, Dr. du Toit expresses the opinion that the majority of geologists acquainted with the deposits adhere to the view that the gold is largely detrital in origin, while not denying that local enrichment has been caused by infiltration. In his extended account of the geology of the Rand the recent development of the Far East Rand and the West Rand is considered in relation to the parent area.

From his own observations in South America, the author is able to institute valuable comparisons between the Devono-Carboniferous stratigraphical succession, facies and structures on the two sides of the Atlantic, and to direct attention to the support that in his opinion these similarities give to the Wegener hypothesis of the drifting apart of the two continental masses.

Although the Great Ice Age as we know it in the northern hemisphere left no evidence of glacial and interglacial epochs in South Africa, a succession of early human industries resembling that in Europe has now been established. Much has still to be done before the stages of cultural development and the climatic oscillations (such as the three wet phases and an arid phase in the Vaal River Basin) can be regarded as satisfactorily correlated, but the valuable contributions to this end by C. van Riet Lowe and his colleagues are usefully summarized.

High praise was extended on the appearance of the first edition of this book. The second edition is even more praiseworthy. The volume is a masterly compilation, attractively written and well illustrated ; it will long be used with appreciation by all interested in South African geology.

P. G. H. BOSWELL.

SURVIVALS AND BELIEFS

English Folklore

By Christina Hole. Pp. viii+184+33 plates. (London : B. T. Batsford, Ltd., 1940.) 10*s*. 6*d*. net.

IN her introduction to this collection of English popular beliefs and customs, the author remarks on the relative poverty of the English tradition in this respect when compared with that of the Celtic-speaking peoples of Scotland, Wales and Ireland. This is in accord with the principle that such peripheral regions as a rule are found through their conditions to have afforded a favourable environment for the survival of the more primitive elements in a culture composed of diverse elements. The resistance of the Celtic-speaking elements in the British population to conquest has also fostered the preservation of tradition.

As a consequence, students of popular custom in Britain have shown a not unnatural tendency to direct their investigations to the richer material of the outlying regions, where the continuity of tradition, though not entirely free from outside influence, on the whole has suffered less dislocation than in England, which has not only been overrun by a succession of invasions by Saxons, Danes and Normans, but also in more recent times has been more completely subjected to the levelling influence of the contacts with outside peoples which has proceeded *pari passu* with the development of communications. Yet, as has frequently been pointed out, this makes of English folk-lore an interesting and at times informative field of cultural analysis.

Miss Hole has drawn her material in part from personal inquiry, in part from printed sources. Of these the more important and fruitful, almost inevitably, have been the invaluable volumes of county folk-lore published by the Folk-lore Society. The classification which she has adopted under the headings of "The World of Everyday", "The World of Nature" and "The World of Magic", has enabled her to cover systematically a field which from the very nature of its content invites inevitably to scrappy treatment. In the first group of beliefs she deals with those which surround the individual from birth to the grave; the second illustrates the attitude of the individual to sun, moon and stars, birds and beasts, trees and plants, and water, wells and stones; and in the third division we have his relation with aspects of the unseen, the world of spirits, manifested in beliefs relating to witches and fairies.

While it is true that much of folk-lore custom died out before the nineteenth century came to an end, this applies more particularly to communal practices enshrining old and forgotten beliefs rather than those more personal survivals from which Miss Hole has drawn a rich selection. Of the more elaborate ceremonial customs, such as, for example, the Abbots Bromley horn dance, probably few would now survive had it not been for the efforts of Cecil Sharp and his colleagues and successors to preserve and revive folk-dance, song and drama. Yet notwithstanding the advance of education, beliefs affecting the individual survive in abundance. The reason is here made clear. It is fear, fear of ill-luck and the unknown. It is therefore not surprising that among the most recent examples quoted are measures to avert the evil influence of the witch. It is, however, interesting to find that Herne the Hunter, his blasted oak, and the white stag, portents of calamity, all appeared in Windsor Royal Forest before the economic crisis of 1931.

ULTRA-VIOLET LIGHT IN TECHNOLOGY

Fluorescence Analysis in Ultra-Violet Light
By J. A. Radley and Dr. Julius Grant. (Monographs on Applied Chemistry, Vol. 7.) Third edition. Pp. xvi + 424 + 34 plates. (London: Chapman and Hall, Ltd., 1939.) 22*s*. 6*d*. net.

THIS valuable work deserves the third edition which it has now attained in a little more than six years. It is twenty per cent larger than its predecessor in the text, in the number of references, and in five more large plates. These last include a photograph in ordinary light and a photograph in ultra-violet light of the faded writing in the Peniarth manuscript, which illustrate in striking degree the possible usefulness of the fluorescence method of examining such museum documents. An even more interesting instance, not illustrated by a plate, is the discovery of alterations in the concluding verse of St. John's Gospel in the "Codex Sinaiticus".

The final chapter (xx) on "The Dyestuffs Industries" is a very useful addition to the book. The general information is very meagre, but there is a wealth of data showing how fluorescence phenomena are influenced by solvents, temperature, inhibitors, decay, etc. on various colour agents. Unfortunately, a few of the paragraphs are borrowed from Chapters xiv on "Organic Chemistry" and xviii on "Textiles" in the last edition, where this part of the subject was then inadequately treated.

Chlorophyll, which came under the general heading "Identification of Colouring Matters" in the second edition, is bereft of any such association, having lost the companionship of "vegetable dyes", which now receive notice in the last chapter. Indeed, the "Identification of Colouring Matters" as a separate section ceases to exist; and the expression does not occur on p. 387, to which the index directs the reader.

Chapter iii deals at considerable length with the subject of "Filters", especially with glasses, and gives many details relative to the composition of glasses. Nevertheless, it appears to make no mention of the well-known didymium glasses, even though it pays tribute to the researches of Crookes in this field (p. 25). It is not clear why "Wood's glass" and the like (p. 33) should be included under "Filters other than Glass", away from "Glasses which Transmit Ultra-Violet Light" (p. 27). This has persisted from the first edition. Perhaps the most remarkable omission in these days of A.R.P. is that there is no mention of luminous paints, or of various fluorescent phenomena which have so long been utilized for advertising and similar purposes. A discussion on the technology of these subjects would be quite out of place in a work devoted to "Fluorescence Analysis", but surely there are analytical aspects which claim suitable notice.

As in the previous edition there are numerous inconsistencies in the text, some merely a matter of English, others technical. For example, on p. 27 one would welcome some comment or explanation by the authors on taking ordinary window glass as unity, even if on the authority of some other worker. Similarly, on p. 1, what was the quality of the glass plate 7 mm. thick which transmitted certain percentages of light at various wave-lengths?

However, the new edition marks a distinct advance on its predecessor, and bids fair to enhance its established reputation. S. J. L.

EFFECT OF NOISES OF WARFARE ON THE EAR

By Dr. T. S. Littler,
University of Manchester

THE rapid development of high-explosive weapons of destruction and attack accompanied by increased blast effects has necessitated increased protection against the possibility of physical injury. The dangers of destructive effects on the sense organs though less obvious have become increasingly serious, and of these impairment of the sense of hearing is of considerable importance. The disturbances likely to endanger the aural and nervous system during bombardments or air raids consist mainly of intense sudden noises of an explosive character. Much information is available on the effect on the ear of these intense noises, and to a certain extent it is possible to minimize or mitigate possible damage to the aural system. Less intense sounds of longer duration which are sometimes referred to as 'horrific noises' and which the enemy have recently introduced as a form of aerial warfare can of themselves produce no damage to the ear. Their panic effect is a psychological one and is calculated to be enhanced by surprise when used without regularity.

The human ear has an upper limit of acoustic pressure beyond which the sensation of sound is accompanied by a sensation of feeling or pain. This limit, known as the threshold of feeling, is a practical upper limit not only for sounds which can be sensed by the ear but near which prolonged exposure may cause damage and temporary or permanent loss of hearing acuity. The acoustic pressure required to attain this limit depends on the frequency of the sound. It is about 3,000 dynes per square centimetre for frequencies of the order of 30–100 cycles per second, but it is only about 600 dynes per square centimetre over the range 200–7,000 cycles per second[1]. Much work has been done on the effect on the ear of intense sounds at pressures approaching the threshold of feeling, and it has been found that such sounds produce definite aural fatiguing effects—effects which may remain for some hours if the sound is sufficiently intense and maintained for a sufficiently long period but from which the ear ultimately recovers. Subjects who have been in the presence of intense noise for very long periods are known to become permanently deaf to certain ranges of frequencies. In the majority of instances the deafness occurs for the upper audible frequencies and corresponds to an inner ear defect near the basal turn of the cochlea.

From experimental evidence it seems that in the case of complex sounds with different wave forms the peak excitation of the basilar membrane is nearer the basal turn of the cochlea the steeper the wave form[2]. It is to be expected, therefore, that greater peak pressures can be endured for slowly rising wave forms than for steeper wave forms. Although the blast pressure encountered during a high-explosive bomb explosion is probably of the order of 10^8 dynes per sq. cm. (100 atmospheres) at the point of explosion, the pressure dies rapidly to the order of 10^6 dynes per sq. cm. (1 atmosphere) a short distance away, after which the disturbance becomes a progressive wave of pulse form in which the pressure decreases linearly with distance from the source. The time interval during which the pressure rises from the undisturbed state to that of maximum condensation depends on the nature of the explosion, but in the case of the high-explosive bomb it is of the order of two or three milliseconds. It is apparently this sudden rise of pressure that produces the greatest

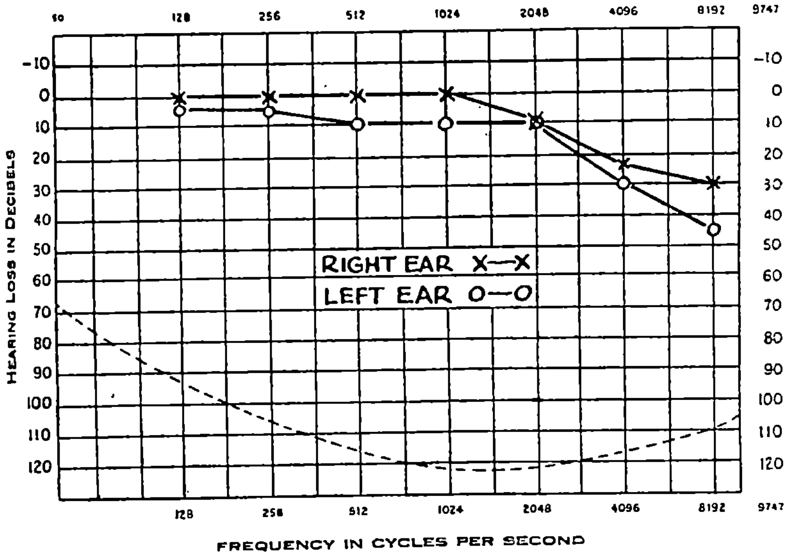


Fig. 1.

Audiogram of pilot after flight of one hour. Ears unprotected.

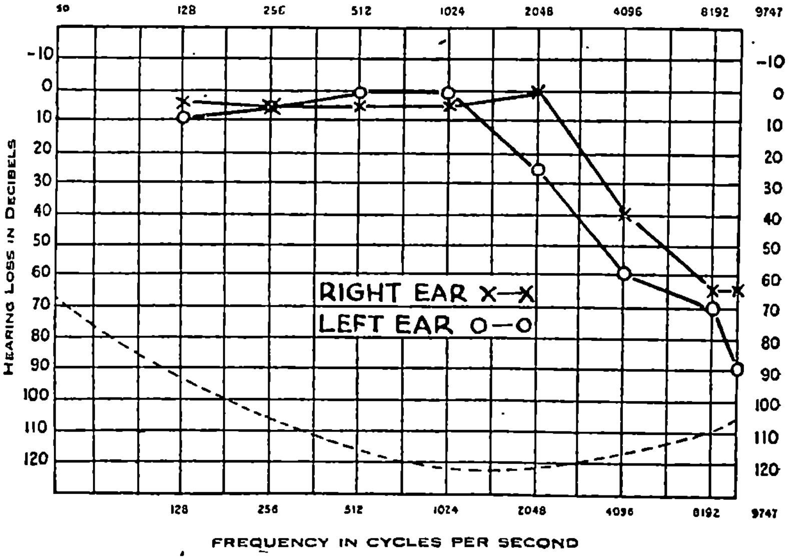


Fig. 2.

AUDIOGRAM OF PILOT SHOWING PERMANENT HIGH-FREQUENCY DEAFNESS PRODUCED WHEN THE EARS ARE UNPROTECTED.

damage to the aural system. This is observed in the case of exposure to gunfire, where it is found the smaller the gun the sharper and more distressing the sound.

Valuable information on the effect on the ear of intense sounds of steep wave front is obtained from hearing tests of aviators before and after certain periods of flying in aeroplanes where the peak acoustic pressure may reach or even exceed that corresponding to the threshold of feeling for pure tones[3]. It has been found that, after flights of one hour in modern types of aircraft, pilots show a severe hearing loss to frequencies in the upper register above 2,000 cycles if the ears are not protected in any way. This deafness is temporary and the subject recovers to normal after a certain period of rest, but if flying is continued for long periods without protection to the ears the deafness becomes permanent. The pilot is not always aware of the disability owing to the high frequencies involved affecting the clarity rather than the apparent loudness of speech received, but an audiometer test demonstrates the defect quite clearly. These results are illustrated in the audiograms of Fig. 1 showing the hearing loss produced in the case of a pilot after a flight of one hour. This temporary deafness does not occur if a helmet or a satisfactory earplug is worn. Fig. 2 shows the hearing curve representative of the type of permanent hearing loss produced after about 200 hours flying without any form of protection for the ears. Now hearing tests made on pilots who have always worn a flying helmet or protected their ears in some way show that hearing can be retained at normal level even after very long periods. For example, Fig. 3 shows the hearing curve of a pilot, representative of many others, who has had a total flying experience of several thousand hours, but has always worn a helmet or protected his ears. The acoustic insulating properties of a flying helmet and of a number of earplugs are given in the accompanying table, where it can be seen that although great insulation is produced for high frequencies the reduction of incident sound for frequencies below 500 cycles per second is very small. Since the main components in aeroplane noise are in the lower frequencies such plugs do not seriously reduce the peak pressure in the wave falling on the eardrum, but by virtue of their high insulating properties at high frequencies they reduce the steepness of the wave front appreciably, thus producing a less damaging sound on the ear.

In the case of explosive sounds the deafening effects are due to single blasts and are of the same nature as aviator's deafness. A detailed study of these has been made by Bunch[4]. In general, there

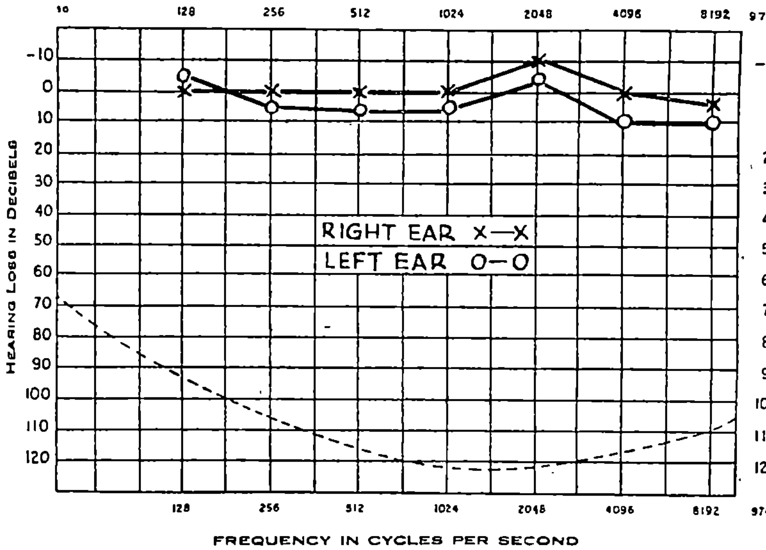


Fig. 3.

AUDIOGRAM OF PILOT WHO HAS ALWAYS PROTECTED HIS EARS.

TESTS OF METHODS OF EAR PROTECTION

Methods

1. Flying helmet firmly strapped so that the telephones and their holders closely seal the ears.
2. Ear defenders.
3. Finger tips in ear.
4. Cotton-wool saturated with 'Vaseline'.
5. Liquid paraffin and cotton-wool saturated with 'Vaseline'.
6. Liquid paraffin and cotton gauze saturated with 'Vaseline'.
7. Meatus packed with 'Plasticine'.

Protection stated as hearing loss in decibels.
(Measurements by air-conduction from a loud-speaker source.)

	Method	1	2*	3	4	5	6	7
Frequency of test	250	5	15	20	15	15	10	10
	500	—	10–30	—	15	20	15	10
	800	15	15–25	25	15	25	25	10
	2,000	25	15–40	25	15	25	40	20
	3,000	—	10–45	—	30	35	40	25
	4,000	35	25-55	35	30	50	50	35

* It proved impossible to fit defenders into the ears with equal tightness in successive tests because the material of which they were made was hard and failed to adjust itself to variations in the shape of the individual meatus.

seems to be no doubt that the parts of the cochlea near the basal turn corresponding to high frequencies are more exposed to shock excitation and the first to suffer any degenerative effects. Stevens and Davis[5] are of the opinion that violent stimulation causes disruptive effects which involve temporary or permanent damage to the hair cells. There are instances where explosive sounds actually produce a rupture of the tympanic membrane, but of itself this is not of a serious nature as the membrane heals rather rapidly—it is the inner ear with its sensitory contents that is so easily damaged. In addition to the effects referred to above, Yearsley[6] points out that true concussion of the labyrinth may occur as a result of a high-explosive wave and reports instances of deafness allied to hysteria after burial in earth thrown up by an explosive.

The methods of protection of the ears against explosive sounds are very simple. One of these, the earplug, has probably been in use for more than a century and has always been used extensively by gunners and others in the presence of intense noise. The other is the buffer, which is a wedge of rubber or resilient material held between the teeth. It is believed to prevent the full shock of an explosion from being conveyed through the bones of the skull. Relaxation of the face muscles, in reducing the rigidity of any exposed part, is an additional protection which reduces blast effects. The table gives some idea of the efficiency of simple plugs. A supply of these such as cotton-wool soaked in 'Vaseline' can easily be carried about the person as a precaution, and in the case of children pads strapped on the ears are an alternative. Earplugs made of hard material are not advisable as they are apt to produce irritation after long periods of use and they have little advantage over more resilient obstructions.

[1] Wegel, R. L., *Ann. Otol. Rhinol. and Laryngol.*, **41**, 740–779 (1932).
[2] Stevens, S. S., and Davis, H., "Hearing" (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 282-284 (1938).
[3] Dickson, E. D. D., Ewing, A. W. G., and Littler, T. S., *J. Laryngol. and Otol.*, **44**, No. 9, 531 (1939).
[4] Bunch, C. G., *Laryngoscope*, **47**, 615–691 (1937).
[5] Stevens, S. S., and Davis, H. H., *ibid.*, 322–27 and 257.
[6] Yearsley, M., *Daily Telegraph*, Correspondence, Oct 29, 1939.

THE CELLULOSE PROBLEM IN WAR-TIME

By Dr. Julius Grant

FROM time to time I have discussed in NATURE[1] and elsewhere[2] some of the problems which face those in the paper, rayon and other industries which rely on fibrous cellulose as a basic raw material. Since some of the most important of these problems have always been subject to the balance of supply and demand, it is not surprising that under war-time conditions they should have acquired a new aspect. In the ten years prior to the War the production of cellulose pulp, particularly from wood, fluctuated uncertainly between a state of inflated prices to one of unprofitable over-production; immediately before the War, in fact, there were even 'scares' of a cellulose pulp shortage. These, however, were scares in the true sense; they did not bear a scientific survey of the cellulose resources of the world, particularly when alternatives to wood pulp were taken into account (see Grant[3]).

It is indeed an interesting reflection on the nature of a situation which aroused so much discussion at the time, that it should so soon have been forgotten. However, the war-time situation which confronts the cellulose-using industries may be summarized briefly as follows; incidentally, it is one of special interest to scientific workers, who rely on the printed word as an essential medium for the spread of information. The extension of the War to Scandinavia has cut off from Great Britain most of her supplies of wood pulp, which were drawn, in order of importance, from Finland, Sweden and Norway. Events in the Mediterranean may well render increasingly difficult the shipping of esparto grass from French African ports, thereby accounting for almost another fifth of our requirements. The only other direction to which are we able to turn is towards Canada, and increasing quantities from that source will no doubt provide us with most of our really essential requirements ; the potential output of Canada certainly is equal to this.

On the other hand, Great Britain is not alone affected. The United States, for example, is by no means self-sufficient in wood pulp supplies, and they have had to rely in the past on Scandinavia for about 1,500,000 tons and on Canada for some 500,000 tons of wood pulp per annum ; with the loss of the former source they too are turning to Canada, and of course for several obvious reasons the latter is better placed to export to them than to us. The threatened wood pulp shortage, therefore, has at last materialized, although in a very acute and unexpected way, so that it is appropriate to review the situation once again in the light of these new events, and to assess the part which the scientific worker can play in dealing with it.

In the first place, the shortage is probably at its most acute stage now. Its severity has caught most consumers unawares, but assuming a long War, as time goes on the output of wood pulp in both Canada and the United States will increase, and the situation consequently will be eased. It may, nevertheless, be assumed with safety that if the War lasts, and if events take even the most favourable turn from the point of view of the supply of wood pulp to Great Britain, a serious shortage will still persist. It seems, therefore, that we must give some consideration to the production of cellulose pulp from such raw materials as are available in Great Britain.

At present these may be regarded as of three classes, namely, materials in use prior to the War, waste paper and new materials. The first category is comprised almost wholly of what are usually called 'rags', although they include materials as far apart as cotton linters and sacking. It is obvious that even under the most zealously organized system of salvage there is little likelihood of an increase of any real importance in the amounts of these available.

Much, too, has been heard on the subject of waste paper ; but here again, although a great deal has been done and much still remains to be done in the direction of salvage, it is evident that a system which brings no new grist to the mill cannot be a complete solution to the problem. Moreover, every time that the cellulose fibre undergoes processing for paper-making it is degraded in quality ; its length—an important factor in determining the response of the fibre to the processes of fibrillation which occur during beating—is decreased, and it loses its capacity for felting, with consequent detriment to the strength and character of the paper. Eventually, in fact, it behaves very much as an 'organic loading', contributing only weight and closeness of texture. A certain amount of virgin fibre must therefore be introduced into many papers in order to provide a 'skeleton', and the more often that a paper is re-used, the greater the proportion it requires ; or conversely, the poorer the grade of paper into which it can be incorporated. In addition, it must be borne in mind that as a result of the recent drastic restrictions in the use of paper the quantities coming back as waste will be correspondingly reduced.

In this connexion there is one aspect of the recovery of waste paper which deserves special attention, and this is the degree of degradation which takes place as the result of the fibre-recovery process itself, as distinct from the process of actual re-manufacture of the recovered fibre into paper. Recovery processes are numerous ; but they usually comprise two stages, namely, disintegration and purification. The former is mainly mechanical in nature, that is to say, the whole or shredded sheets of paper are agitated violently, usually with hot water which often contains free alkali, the purpose of which is to dissolve the resinous size which coats the fibres and helps to bind them together. It seems that this part of the process allows of little modification which might decrease the extent of the degradation of the fibre. The other stage of the process is, however, mainly chemical in nature, and varies according to the impurities present. The most important of these is usually ink, and the problem may differ considerably according to the nature of the ink. Thus, writing ink is removed with comparative ease with the aid of bleaching agents, and bleaching powder figures prominently among those used in spite of its adverse effect on the strength of the fibres.

Unfortunately, writing ink seldom occurs alone ; it is almost always accompanied by printing ink, and since most common printing inks are made up on a carbon basis, the question of removal becomes more difficult. The scientific basis of printing ink removal depends, first, on the destruction of the medium (usually an oil) in which the ink is compounded ; secondly, on the removal of the particles of the carbon from the fibre ; and thirdly, on the separation (after their removal from the fibres) of as many of these particles as possible, with a minimum loss of the fibres. The first requirement is easily satisfied by the use of alkali, so long as the oil is saponifiable, and it is assisted materially by the use of emulsifying and wetting-out agents. Newsprint inks, however, are made up with mineral oils, and are therefore an exception. Fortunately such oils have a relatively poor binding effect on the carbon, and this to some extent compensates for any difficulty in decomposing them. Owing to the chemical inertness of the carbon, however, its removal from the fibres depends almost entirely on mechanical action. The mechanism underlying removal in this way is still imperfectly understood, and is proving a fruitful field of investigation; it seems, however, that under suitable conditions of combined rapid flow and agitation the individual fibres may be made to scour one another mechanically, and so to remove the particles of carbon on their surfaces. As might be expected, the presence at this stage of substances having detergent or wetting-out properties is again advantageous, and these are frequently used. This stage of the operation, therefore, need have little influence on the quality of the fibre.

The final stage, namely, separation of the particles of carbon, is the most difficult of all, because both the fibres and the carbon have dimensions and specific gravities of the same order, thereby eliminating to a great extent selective flotation or screening methods. In general, the greater the degree of cleanliness required the greater is the loss of yield at this stage owing to removal of fibre with the carbon. However, some degree of success has been achieved by the use of substances producing a froth which collects the carbon and so enables it to be skimmed off; froth-formation, unless it can be controlled, is, however, definitely objectionable. It is sounder to add an adsorbing agent such as china clay, or bentonite, or to precipitate an amphoteric oxide (for example, silica) *in situ*, as these fix the carbon by adsorption and later can be separated with it by means of a washing-drum. Where a final high quality is not of the first importance a compromise may be struck by separating most of the carbon (even at the expense of loss of yield), and dispersing the remainder in a very finely divided state throughout the bulk of the fibres. If this is done efficiently the particles of carbon cannot be seen as such; the final pulp is merely a shade more grey.

Devices of this nature have in common the reduction of damage to the fibres to a minimum. Nevertheless it is apparent that even under the most favourable technical and economic conditions, the re-use of waste is not a complete solution to the cellulose problem. There remains, therefore, the third alternative, namely, the utilization of home-produced raw materials. Numerous factors determine whether a particular material can be used in peace-time as a source of cellulose. In war-time some of these (and especially those which refer to cost) are of less importance, but the essential criteria remain. In order of importance these are: (1) availability (that is, regularity of supplies, quantities available, and ease of harvesting, collection, etc.); (2) yield; (3) ease with which the non-fibrous constituents may be removed (or quality of the final pulp); (4) suitability of existing plant for dealing with such raw materials; and (5) cost. In peace-time the order is different; cost and quality come nearer the head of the list, whilst the necessity to use existing plant is of less importance.

It should be pointed out at this stage that practically every vegetable material of a fibrous nature may be converted into cellulose pulp of one kind or another, and that ever since the shortage of rags which arose after the invention of paper-making by machine in the early nineteenth century, projects have been put forward for the utilization (for paper-making, at least) of every conceivable vegetable material from manure, peat and nettles to tree-wood. It is therefore highly significant that in spite of all this the cellulose requirements of Great Britain should have been derived solely from three raw materials of vegetable origin, namely, wood, esparto grass and 'rags'; indeed, the two latter account for only about 20 per cent of the total and are used only by virtue of special properties they possess. The position is much the same elsewhere in the world. Esparto is not used to any great extent, but in its place may be set various fibrous materials which, owing to local conditions, are favourably placed; straw in Holland, and bamboo in India are examples.

The reason for this is apparent if one applies the criteria of suitability set out above, because in almost every instance the question of cost proves to be the deciding factor. It has, in fact, ruled out everything except waste products (that is, materials for which there is no other use), and even then costs of collection and transport, combined possibly with poor yields, have brought the price of the final pulp to a figure which is not competitive with that of wood pulp. Since this is the case, under war-time shortage conditions one of the principal objections is removed, and the whole question may be reconsidered in this light. The result is that many home-produced raw materials which were previously rejected on the basis of the above criteria, now become interesting possibilities.

By far the most important of these is straw. It is a crop which is produced regularly and in large quantities; it can be collected and handled relatively easily, and its yield of bleached cellulose pulp (35–40 per cent), though on the low side compared with, say, esparto, may be regarded as satisfactory. There are, it is true, other uses for straw in the farming industry, but under modern conditions it is no longer essential for many of these, and it seems that the quantities available are adequate to safeguard a large proportion of our war-time cellulose requirements. Fortunately, too, straw may be processed in most of the existing plant previously used for rag and esparto; certain modifications are required, but these are of a minor character, although owing to the bulky nature of the original straw and the difficulty of packing it into the digesters it is not possible to obtain the same output.

In Great Britain the only pulp plants available for such purposes are those operating an alkali process. The straw is then boiled in digesters under a pressure of 50–60 lb. per square inch with 15–20 per cent of its weight of caustic soda for some three hours. Under these conditions those constituents of the plant structure (such as lignins, pectins, gums, resins and carbohydrates) which serve to cement the cellulose fibres together, are rendered soluble, leaving free the skeleton of cellulose fibres. The cellulose is, however, not entirely unchanged, but undergoes a process the chemical nature of which is as yet imperfectly understood, although it appears to be allied to mercerization. The result is that the pulp acquires a greasy or gelatinous consistency which renders difficult the subsequent operation of removal of the soluble impurities by washing. Furthermore, the manufacture of paper from cellulose pulp is essentially a drainage process, and this, too, is retarded if the pulp is at all gelatinous. This is a characteristic of straw which makes it much more difficult to deal with than, say, esparto, and it presents a problem which may be attacked in two ways, namely, by improvements in methods of washing or by carrying out the digestion under less drastic conditions.

If the latter course is adopted the decomposition of the non-cellulose impurities may be less complete, and this applies particularly to those in the parts of the straw (such as the nodes) where the physical structure is more dense; it applies also to extraneous fibrous matter such as weeds. Certain of these (such as the dock) are far more resistant to attack by alkali than is straw itself, and when even a few of these partly digested particles are broken up in the subsequent operations, they appear in the final product as numerous small brown specks, known collectively as 'shive'.

In spite of this, however, the gelatinous character of straw pulp is such a serious drawback that further work on the elimination of shive becomes most desirable. One method of attack has been by means of a modified method of bleaching[2]. In the past the operations of digestion and washing have been followed by the addition of an excess of a solution of bleaching powder, the residual bleaching agent being washed out when the pulp has attained its maximum colour. One advance on this has been the bleaching of the pulp in two stages, about one half of the total quantity of bleaching agent required being first used; when this is exhausted the pulp is washed, and the remainder of the bleaching agent is added. The principal advantage of this method is the economy in bleaching agent which it effects; but it has also led the way towards further improvements (also along the lines of bleaching in stages) which have enabled more resistant materials such as weeds to be dealt with.

The most important of these is based on a principle similar to that of the original Cross and Bevan method of isolating cellulose, namely by chlorination. The first stage of the process, therefore, is treatment with chlorine, either as gas, as chlorine water or as an emulsion of the gas in water. If it is carried out under the correct conditions this stage has the effect of chlorinating the lignin almost selectively, with the formation of hydrochloric acid from the hydrogen atoms so displaced. If the pulp is then made alkaline, this acid is neutralized, and the chlorolignins are dissolved, so that after it has been washed the pulp is ready for the real bleaching operation, which is carried out with bleaching powder solution in one or more stages. Processes of this kind make possible the treatment of the more resistant plant materials, especially if these contain much lignin, and moreover the degradation in strength which inevitably accompanies the purification action of chemical reagents on cellulose is minimized. If, however, such processes are to be used to the best effect they require careful control; the influence of working conditions such as the concentrations of pulp and of bleaching agent, temperature, *p*H value and time are all of importance, and are the subject of active investigation.

So far special reference has been made to straw, partly because from the point of view of supplies it is the most promising source of cellulose available in Great Britain, and partly because elsewhere (and notably in Holland, Italy, and South America) it has already played an important part in supplementing or displacing wood pulp. There are, however, a number of likely though possibly less attractive alternatives available here, and experiments have already been made on materials such as Norfolk reeds, bracken, peat, potato and tomato haulms, sunflower stalks, linseed straw, hop waste and hop vines. These, however, vary considerably in their response to treatment, even by chlorination, and although it is possible to make cellulose pulp of a kind from each of them, when this is judged by the resultant criteria of yield, colour, strength and cleanliness, they do not equal weed-free straw; moreover, as a rule they are neither so plentiful nor so easily collected as straw. Nevertheless, they may well serve to supplement straw, particularly in war-time, and some of them by reason of their strength may suitably be used to reinforce straw pulps.

Finally, it may be pointed out that although this concentration on home-produced raw materials is a direct result of war-time conditions, it may well prove to be the foundation of an attempt to render Great Britain permanently independent to a great extent of imported cellulose ; this would, in fact, be no more than to follow a precedent, already set in a similar way in Germany and Italy. If, however, this prospect is to mature, it seems to call for an organized attack on the many and various aspects of the problem involved. Not only are there the technical questions of pulp production outlined above, but bound up with these are matters such as the cultivation of straw containing the minimum quantities of weeds, and of straw which will give the maximum yield of cellulose fibre. The claims of the other uses to which straw is put at present will also have to be taken into account, and in fact the whole matter is obviously very closely bound up with the agricultural policy of the nation.

---

[1] Grant, J., NATURE, 139, 867 (1937) ; 140, 314 (1937).

[2] Grant, J., "Wood Pulp" (London : Wm. Dawson and Sons, 1938).

[3] *Chem. and Ind.*, 58, 613 (1939).

OBITUARIES

Prof. William Frecheville

WILLIAM FRECHEVILLE, who died on July 30, was born in 1854 at Halifax, Nova Scotia, the son of R. R. F. Frecheville, barrister-at-law. Educated largely in England, he entered the Royal School of Mines in 1871, and in 1875 graduated in mining, metallurgy and geology. From that date until 1889 he held mining appointments abroad in different countries and in various capacities. With this experience he established himself as a consulting engineer in London, where his professional reports were greatly valued by reason of their sound recommendations and his uncompromising integrity. This work again took him to every land and to every sort of mine ; and in 1905 he was elected president of the Institution of Mining and Metallurgy.

It was not surprising, therefore, that in 1912 he was invited to allow his name to go forward for the then vacant chair of mining at the Royal School of Mines, Imperial College of Science and Technology. That he should have accepted this invitation to take up an academic appointment when he might well have continued a successful consulting practice or even have retired was in keeping with his inflexible will to work and his dauntless spirit. With nothing previously prepared and nothing to build upon except his own unassailable experience and his reading, he nevertheless set about and completed in time a series of systematic lectures on the mining subjects which fell to him as head of the department he took over. At the College his natural dignity and unfailing courtesy made him at once acceptable to his colleagues of the professoriate, by whom he was shortly afterwards elected as one of their representatives on the Governing Body.

In his own department Frecheville set himself the unpopular but cleansing task of putting down excessive coaching of students by members of the staff, permitting coaching only where there had been unavoidable absence from the adequate teaching which the College provided and for which the parents of students paid. Carrying on with a diminished staff, and fewer students, during the War of 1914–18, he was there to accommodate the influx of the large number which followed upon demobilization ; until in 1919, having by then a staff of his own selection and seeing one whom he could recommend to take his place, he resigned. In that same year the Institution of Mining and Metallurgy made him an honorary member in acknowledgment of his eminence in the profession and of the public spirit which prompted him to give students the benefit of his ripe experience ; in that year also he was made an emeritus professor of the Imperial College. Two years later he placed the sum of £2,000 at the disposal of the College for initiating research fellowships in mining and metallurgy, all of which was spent in useful awards for such work. Further distinction came when in 1926 he was awarded the Gold Medal of the Institution of Mining and Metallurgy ; and again in 1932 when he was made a fellow of the Imperial College—one of its first fellows.

In private life Prof. Frecheville was the courteous English gentleman. Married in 1890 to Helen, daughter of George Hamilton Penny of Sydenham, he celebrated earlier this year with his wife their golden wedding, the announcement being made in terms expressive of the swift but happy passage of time. Their one great grief was the loss of their only son, an officer in the Royal Engineers, who having fought through the War of 1914–18, went on to fight and to meet his death in Russia. Prof. Frecheville is survived by his widow, five daughters and grandchildren.

S. J. TRUSCOTT.

Major P. H. G. Powell-Cotton

WE regret to record the death of Major P. H. G. Powell-Cotton, zoologist, anthropologist, and one of the best known of big-game hunters in the world, which took place on June 26, at the age of seventy-three.

Percy Horace Gordon Powell-Cotton was born on September 20, 1866. He was educated privately and commissioned in the 5th Battalion the Northumberland Fusiliers, attaining the rank of major before his retirement. The greater part of his life, however, was devoted to travel, big-game hunting, and the collection of zoological specimens and ethnographical objects. The museum which he founded on his estate at Quex Park, Birchington, Kent, was one of the finest private collections in Great Britain, and had he been able to carry out the extensions which he had planned before the outbreak of the War, would probably have been one of the most attractive exhibitions of big game in the world.

For nearly forty years Powell-Cotton was engaged almost continuously in conducting big-game hunting and collecting expeditions. Among the earliest scenes of his activities was Western Tibet, where he travelled on three occasions. In Africa there was scarcely a remote, and in his earlier days little-known, part of the continent which he had not visited. He crossed Somaliland; and in a journey from Mombasa to the White Nile passed by way of Mount Kenya and Mount Elgon, and Turkana and Latuka, when these regions were indeed strange lands. Lado Enclave and Lake Edward were reached through the Ituri forest, and the Cameroons were visited three times; while Tanganyika, Southern Angola and South-West Africa were some only of the scenes of his exploits.

Powell-Cotton's interests were not merely those of a big-game hunter. He was also keenly interested in zoological and anthropological science. In zoology many new species have been associated with his name; and his collections exhibited in the public and private galleries of his museum at Birchington were readily placed at the disposal of students of zoological and ethnographical science. In anthropology, as was shown in his communications to the proceedings of the Royal Anthropological Institute, a profound sympathy with the point of view of the black man did much to compensate by accuracy of observation and understanding for a lack of systematic training. He was deeply interested in primitive arts and crafts and had brought together long series from almost every part of Africa, as well as from Tibet. At the same time he was a generous donor to the collections of the Ethnographical Department of the British Museum. In addition to communications in scientific periodicals, Powell-Cotton was the author of "A Sporting Trip through Abyssinia" and "In Unknown Africa".

CAPTAIN GUY DOLLMAN writes: "I have been a frequent visitor to the Powell-Cotton Museum during the last twenty or thirty years and have witnessed its growth and expansion from a comparatively small collection to the finest private museum in Great Britain; in fact, it would not be an exaggeration to say that this museum is one of the foremost private museums in the world.

"Powell-Cotton specialized in presenting geographical groups of animals in his exhibition galleries and nearly all the specimens exhibited were close on record examples. With the exception of some specimens shot by Mrs. Powell-Cotton and others by the Misses Powell-Cotton, all the exhibits were personally collected by the Major. In the central gallery there is a magnificent group of African game animals, including the largest elephant which has ever been brought out of Africa, and the collection of elephant tusks contains some of the finest of specimens.

"Recently some new groups have been arranged in new galleries and some of these show a gradual transition from marshy surroundings to desert and mountainous environment. Here we have exhibited some of the Nyalas shot during Major Powell-Cotton's fairly recent expedition in south-east Africa. Among the desert animals is the new wild ass collected by Miss Diana Powell-Cotton, to which I gave her name when describing it. In the mountainous series are shown Barbary sheep and African ibex. There are also cases containing a fine group of Asiatic ibex, sheep and goats and others are filled with collections of apes and monkeys, the Cameroon gorilla group being especially noteworthy.

"In addition to the natural history specimens exhibited there is also a very extensive collection of ethnographical material, and quite apart from the exhibition branch of the museum there is a very large study collection which is available to students from all over the world. This has been consulted on many occasions by the principal mammalogists throughout Europe and America, and resulting from the work of these experts the Powell-Cotton Museum is extremely rich in type specimens.

"Of recent years the museum at Quex has become more and more a family affair. The Misses Powell-Cotton, in addition to accompanying their father on some of his trips to the Red Sea Province and Zululand, have also undertaken expeditions of their own into Angola, where considerable additions to the museum were obtained. Powell-Cotton's last two expeditions were to South-West Africa and Tanganyika Territory; on the former trip he was accompanied by his son, and on the latter expedition Mrs. Powell-Cotton did much of the shooting."

WE regret to announce the following deaths:

Mr. W. C. Burnet, secretary to the Delegates of the Local Examinations, University of Oxford, on August 3, aged sixty-three.

Dr. R. Hanitsch, director of the Raffles Museum and Library, Singapore during 1895–1919, on August 11, aged seventy-nine.

Mr. A. H. Howell, senior biologist of the Bureau of Biological Survey of the U.S. Department of Agriculture, an authority on the geographical distribution of mammals and birds, on July 10, aged sixty-eight.

Sir George Macdonald, K.C.B., F.B.A., permanent secretary of the Scottish Education Department during 1922–28, an authority on numismatics and the history of Roman Britain, on August 9, aged seventy-eight.

Sir Daniel Thomas, known for his sociological, educational and antiquarian work in Wales, also for his work in the foundation of the National Library and the National Museum of Wales, on August 8, aged seventy-six.

Prof. N. T. M. Wilsmore, professor of chemistry in the University of Western Australia during 1913–37, formerly assistant professor in University College, London, on June 12, aged seventy-two.

NEWS AND VIEWS

Element 85

It is announced that Dr. W. Minder, of the University of Berne, has succeeded in isolating element 85. This, it is claimed, has been produced in small quantities from the decomposition of actinium, which is radioactive. Dr. Minder has named the new element 'helvetium' in honour of his country. It is hoped that further details of this claim will be available shortly. Commenting on this announcement in the *Evening News* (London) of August 13 is of such encouraging significance as to be worth placing on record. This newspaper says: "It is odd to learn to-day, in the midst of war, that a patient Swiss scientist has succeeded at last in isolating the elusive chemical element '85'. It is still odder to reflect that in the long view of history a discovery of that sort may rank above all the perils and victories of these days."

The Purchase Tax and Literature

It was announced by the Chancellor of the Exchequer in the House of Commons on August 13 that newspapers, books and periodicals are to be exempt from the proposed purchase tax. He stated that he feels it would not be in the public interest at this time of war that there should be any decrease in the circulation of newspapers or any diminution of the services they provide for the public. This announcement will undoubtedly give satisfaction to all scientific workers. There is no doubt, however, as pointed out in the leading article entitled "Books in Wartime" in NATURE of May 11, p. 719, that this welcome decision is of much greater significance than would seem superficially. Sir Kingsley Wood added that books are to be exempt from the tax "at least for the present". It is to be hoped that, for the important reasons set out in the abovementioned article, the future will not bring any significant change in this new policy.

The New World Order

In his Cawthron lecture, 1939, "Some Problems of the New World Order" (Nelson, New Zealand: Cawthron Institute, 1939), Dr. G. H. Scholefield, pointing out that the raw material of political science is man in his organization for life, the family, the community and the nation, where the reactions of mankind are not so well known and precise as in biology or chemistry, gives a brief review of the sources of our liberty, the post-War revolutions and the rise of the dictatorships. Tracing the growth of German aggression, he emphasizes that with the destruction of dictatorship, the problem of settling Germany in a peaceful and prosperous state will remain and will involve some sacrifice. The great danger in such a war as this is that it may end before our leaders have fully studied how best to make peace and how to arrange international relations in future. This will involve attention to economic matters and the solution of problems of social organization.

Science and invention should alleviate man's labour, enable him to maintain himself by working shorter hours and to devote a greater proportion of his time to rest, to pleasure and to cultivating the arts. Failure of the social sciences to keep pace with the applied sciences has led to the position that the human race can produce all that is required for its material well-being with quite a light amount of personal labour while we have not devised means for all potential consumers to obtain possession legally of what they require. Neither Germany nor the democracies have solved the problem of absorbing unemployment and bringing mechanization under social control. Finally, Dr. Scholefield briefly touches on the possibilities of an international federation of States.

India's Future and the Constitution

Once again the British Government, notwithstanding the preoccupations of war, has turned aside to direct its attention to furthering the interests and promoting the welfare of a people for whom it accepts imperial responsibility. The statement of policy made by Lord Linlithgow, Viceroy of India, on August 9 and by Mr. L. S. Amery, Secretary of State for India, on the same day in the House of Commons was framed with the object of enabling the people of India to fulfil their anxious desire to contribute fully to the common cause in the present world struggle, and to ensure the triumph of our common ideals. In brief, the British Government proposes in the interests of Indian national unity, and notwithstanding the differences between parties which previous discussion has shown to be still unbridged, that the Viceroy's Council should now be expanded to include representatives of the political parties, and further that a consultative committee should be established which, as a war advisory council, will meet at regular intervals and will include representatives of the Indian States and of other interests in the national life of India as a whole. The statement of policy goes on to say that while it is clear that the present moment when the Commonwealth is engaged in a struggle for existence is not one in which fundamental constitutional issues can be decisively resolved, yet the British Government is prepared to undertake to set up at the close of the war a body representative of the principal elements of India's national life in order to devise the framework of a new constitution.

The state of tension between the various elements of the political situation in India at the present time is too well known to need stress. It has led to a deadlock, and lays it open to doubt whether the democratic idea has obtained a more than superficial acceptance in the minds of powerful sections of the

Indian population. The British Government is not blind to this aspect of the situation. While making it clear that Dominion status is its objective, it has laid it down without ambiguity in this statement of policy that the British Government cannot be a party to the coercion of any elements of India's national life into obedience to a system of government whose authority those elements do not accept. Secondly, it is declared categorically and insistently that the framework of the scheme for the future government of India should be primarily the responsibility of Indians themselves, and should originate from Indian conceptions of the social, economic, and political structure of Indian life. Subject to responsibilities from which His Majesty's Government cannot divest itself, it desires to see Indian conceptions given the fullest expression. This statement of policy made on behalf of His Majesty's Government is a bold and timely step forward to promote national unity among the Indian peoples. Its success or failure depends upon the people themselves. For while it embodies those principles of social justice which would submit the form of government to the determination of the peoples themselves, its translations into practical effect is clearly made to depend upon the display of that spirit of toleration, the exercise of that mutual co-operation, and that freedom from coercion which is the essence of the democratic ideal.

Colour-Blindness and Camouflage

THE chief characteristic which distinguishes colour-blind people from those with normal vision, is a reduced ability to distinguish colours that are normally quite distinct. Superficially, therefore, it would seem highly improbable that colour-blind persons could detect a camouflaged building that an ordinary observer would miss. This suggestion, however, which has come from the United States recently, is not wholly without foundation, as there are at least three ways in which certain colour-blind observers might see more than the ordinary person. For example, in a building camouflaged with large irregular patches of colour, the actual outline of the building may be lost in the jumble of these patterns. But the colour-blind person may be scarcely conscious of the variegated colours, so that to him the outline of the building may be almost unaffected by the camouflage. In the Ishihara test for colour-blindness, certain of the cards actually use this principle ; a faint blue figure is printed on a background of highly coloured dots of various hues. To the normal observer the blue figure is lost against the background, but the colour-blind person may spot it. Again, in the protanopic and protanomalous type of defect, reds and yellows appear darker than usual, and with certain colouring of building and background this could lead to an enhanced contrast and so give the colour-blind person his advantage.

That a third very hypothetical case is possible, is shown by the fact that, using a colorimeter, it is possible for a normal observer to make a colour match between two halves of a field that would not be a match for a defective observer of the anomalous trichromat type. It could therefore be argued that it might happen that a building matched its background for the normal person, yet, for the anomalous trichromat, the two would be distinct. But for every instance of this kind that might be suggested, there are innumerable examples in which the colour-blind observer is at a marked disadvantage, and in other ways would of course be a source of real danger. Moreover, if the normal person were provided with pieces of coloured glass, it would be most unlikely that the colour-blind person would ever be able to score off him.

University of London

THE report of the Principal on the Work of the University of London, 1939–40, gives a short account of the officially recommended dispersal of the various schools. The result was a heavy demand on those who received the evacuees, the Universities of Cambridge, Bristol and Wales in particular. The intensive air-raids which were expected not having yet arrived, Birkbeck College has re-opened for day and evening classes. The Imperial College of Science and Technology has remained open at South Kensington for several courses in chemistry, physics, and mining, and the London School of Economics with day teaching at Peterhouse has maintained evening classes in London. Bedford College went to Newnham, and Westfield to St. Peter's Hall, Oxford. The agricultural students at Wye went to Reading for the first term, but the College was re-opened for teaching last January. The British Postgraduate Medical School and the Lister Institute remained in London, and nearly all the other medical schools are now there again, and would plainly lose by dissociation from their special hospitals. The Government decision not to call up under the age of twenty led to some trouble in unexpected accommodation. At the end of August the Ministry of Information took over the Senate House, and the new wing designed for the Institute of Historical Research, when finished, will also be occupied by the Ministry. The University was due to receive a grant of £25,000 from the National Fitness Council towards the new Students' Union, but that was vetoed by the Treasury on the outbreak of War. Lord Nuffield gave twice as much, and on being asked if in the altered circumstances he would withdraw the gift, wished it to be retained for building in happier times.

It is good to learn that the work of the University goes on satisfactorily. Examinations have been held in eleven provincial centres, and there has been no lowering of standards. The University has had to provide for a large number of external students, and the Extension Department has made up for the falling off of its normal work by attending to the education of British and Canadian soldiers. The War will reduce the supply of students, though the numbers at present keep up rather well, so that the question of adequate financing will become urgent. The decision not to reduce the Government grant is important. That of the L.C.C. for this year is much less, but other contributing bodies, we are glad to see, continue their support as usual. The Senate has wisely decided to retain its Publication Fund for works of science and learning on the scale which funds allow. Grants amounting to £1,583 were made last session. Among the benefactions we notice £25,000 in seven annual instalments for rebuilding at Queen Mary College from an anonymous donor, £2,660 from the Duke of Bedford for a fellowship in medical radiology at the Middlesex Hospital Medical School, a donation of £250 for one year from the Iraq Petroleum Company converted to twice as much for seven years, and £250 a year for seven years from the Gaekwar of Baroda to make a lectureship in Marathi a full-time post.

Pioneering in Educational Radio

Dr. C. G. Abbot, secretary of the Smithsonian Institution, has announced that a period of four years of pioneering in educational radio was completed on June 9 by the Institution. The object was to increase and diffuse knowledge among the people generally. The title of the popular series of broadcasts was "The World is Yours". In addition to science, the main theme of the series, the broadcasts dealt with exploration, history, engineering and invention, and art. A few recent titles will show the wide diversity of subjects treated: "Stars in the Sky", "The Indians who met Columbus", "Earthquakes", "Flying in Safety", "Cortez, the Conquistador", "Pompeii Lives Again", "Radium", "Dinosaurs". Since the programme was inaugurated on June 7, 1936, "The World is Yours" has expanded from its original 27 stations to a network of 82 stations covering the United States. The most recent, and the highest tribute paid to the series came last February when a leading American radio audience research service announced that the Smithsonian dramatizations received the highest rating of all serial programmes on the air. This followed from an analytical survey of all the programmes given on all networks.

To promote further this 'increase and diffusion of knowledge', the educational value of these programmes is preserved by the Educational Radio Script Exchange, U.S. Office of Education, Federal Security Agency. Hundreds of school and civic groups have used these scripts for production by radio and over sound systems. Another new radio service began last October with the inauguration of *The World is Yours Magazine*. Dedicated to the popular theme, "catch it by radio—fix it in print", these weekly magazines present a wide variety of articles by Smithsonian curators on historical, scientific, and engineering subjects for lay readers and schools. Some of the features of these new 'doors' to knowledge are dramatic scenes from the script, selected bibliographies for further study, recent news from the Smithsonian, and illustrations from rare drawings and photographs in the files of the Institution. Nearly 100,000 copies of these have been sold in the first half-year, the sales being on a non-profit basis. "The World is Yours" is produced for the Smithsonian Institution by the U.S. Office of Education with the co-operation of the National Broadcasting Company and with the assistance of the Work Projects Administration.

Regulation of the Upper Mississippi

The Mississippi and Missouri, together, form the longest river system in the world, extending to a length of 4,502 miles. Above its junction with the Missouri, the Mississippi has a length of 1,170 miles and drains an area of 171,500 square miles. In an article in *Engineering* of July 19, a description is given of that part of the Upper Mississippi lying between the Missouri and the town of Minneapolis in Minnesota, 659 miles long. In 1907, a project was adopted for the regulation and improvement of the river from Missouri to Minneapolis in order to provide a 6-ft. channel at times of minimum flow. The work carried out consisted mainly of dredging and the construction of wing dams to restrict the width of the low-water channel. Twenty years later, the U.S. Congress directed that a survey of the river should be taken with the view of providing a low-water channel with a depth of nine feet. The project involved the construction of a series of locks and dams, and fairly extensive dredging. The work was completed last March at a cost of 170 million dollars. Twenty-five dams were required, and special Tainter and Roller gates were used for regulating the flow. The gates of later construction are designed so that they can be lowered several feet below the normal level of the pool, allowing even heavy ice to pass over the top.

The principal traffic on the Upper Mississippi River consists of fleets of barges, usually pushed by steamers of the stern-wheel or twin-screw type. The barges range in length from 100 ft. to 300 ft. and in beam from 24 ft. to 48 ft. The capacity varies from 500 to 3,000 tons. A tow of barges, practically filling one of the 110 ft. by 600 ft. locks, carries 6,000–8,000 tons of goods, and requires a 1,000 h.-p. steamer for its propulsion. In operation, it is possible to pass about fifty fleets of barges through the locks in twenty-four hours. The fifty-two over-bridges between Minneapolis and the Missouri River in general provide vertical clearances above high water in excess of 50 ft. and horizontal clearances varying from 106 ft. to 710 ft. Traffic on the river consists mainly of coal, petrol, fuel oil, steel-products and grain. The total tonnage handled between Minneapolis and the Missouri in 1936 was 2,300,000 tons.

Strengths of Indian Timbers

Ever since the inauguration of the Imperial Forest Institute at Dehra Dun, one of its branches has been engaged in testing out the strength and properties of indigenous timbers. Many timbers hitherto neglected or regarded as useless for practical commercial purposes are now coming under the tests of the research investigators. The Timber Testing Section of the Forest Research Institute has been studying the strength properties of Indian timbers for many years now, and more than 215 consignments of timber have been tested up to date. In *Indian Forest Records*, (*Utilization*) 1, A (Govt. of India Press, New Delhi 1939), Mr. V. D. Limaye gives authentic information, on the possible uses and comparative strengths of thirty-six common Indian timbers and of six commonly imported timbers (three of which come from Burma) of different genera and species. This demonstrates the wealth of fine timbers there are in India. Yet three quarters of a century ago or less the bulk of the population in India, including the British, relied chiefly on three timbers only, according to situation—teak, sal (Shorea) and deodar.

Meteorology of the Australasian Antarctic Expedition

THE Australasian Antarctic Expedition of 1911–14 under the leadership of Sir Douglas Mawson seems an episode of the remote past, for so many better equipped expeditions have intervened. The latest of the scientific reports of this expedition is the fifth of the series and is in three parts (Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series B, Vol. 5: Meteorology. Part 1: Records of the Queen Mary Land Station; Part 2: Meteorological Log of the S.Y. "Aurora"; Part 3: Sledge Journey Weather Records; Appendix, Macquarie Island Weather Notes for 1909–1910–1911. Pp. x+282+4 plates. Sydney: Government Printer, 1940. 40*s*.). It is concerned with meteorology. Part 1 of this volume deals with the records of the Queen Mary Land station—the 'Grottoes'—in latitude 66° S., longitude 95° E.; Part 2 covers the meteorological log of the S.Y. *Aurora*, and Part 3 the weather records of the sledge journeys; an appendix includes the daily weather records made at Macquarie Island by Otto Bauer's sealing party from August 1909 to July 25, 1910, and January 1 to December 12, 1911.

Although the report is largely statistical, there are some excellently reproduced photographs, at the end of the volume, of scenes of meteorological interest. Four of these show characteristic features of the edge of the Antarctic Continent that must, judging from the descriptions of others who have written about the same subject, be very typical. Thus, in Plate 4, Fig. 2, a canopy of strato-cumulus cloud is seen over Commonwealth Bay, with cloudless sky over the continent to the south. It is a scene of peace and beauty, the ripples in the sea showing that there was only a light westerly wind blowing. In Plate 3, Fig. 1, the sky is still partly cloud-free; but the clouds look like alto-cumulus and the horizon is a dark smudge indicating the approach of a blizzard. In Plate 4, Fig. 1, a sledging party on the plateau interior of Adelie Land appears to be preparing to weather a blizzard that is presaged by dense masses of cirrus cloud. The sequence is completed by Plate 2, Fig. 2, in which cumulo-nimbus clouds are breaking up just after a blizzard north of the Mertz Glacier Tongue. The bulk of the volume consists of undiscussed meteorological tables, but a footnote to p. 16 says that "Dr. E. Kidson has been engaged preparing two volumes analysing and discussing the Expedition's meteorological data. This will be published in due course".

Epidemiology in the Army

IN a recent article (*Ann. Int. Med.*, 13, 2229; 1940) Lieut.-Colonel J. S. Simmons, of the Medical Corps of the United States Army, divides the hazards of military life into three groups according as they arise in peace-time service, during mobilization or in actual warfare. In peace-time the soldier's life is as safe as, if not safer than, the civilian's, as he has been carefully selected, housed in modern barracks, fed on a balanced diet of wholesome food and forced to take adequate exercise. He is trained in physical hygiene, and his health is under medical supervision. During mobilization, though efforts are made to continue existing medical facilities, the rapid accumulation of susceptible recruits from all parts of the country frequently results in epidemics. In actual warfare, the soldier is not only faced with the risk of injury and death from battle, but is also exposed to infection. Between April 1917 and December 1919 when the United States Army was engaged in that War the casualties from all quarters were 50,000 deaths due to battle and 58,000 deaths caused by disease. The principal diseases to which the soldier is exposed during mobilization and war are wound infections, the morbidity and mortality of which have undergone a striking decrease since the introduction of antiseptic surgery, gastro-intestinal infections due to contaminated food and drink, including enteric fever, dysentery and cholera, venereal infections, the admission rate for which in the United States Army was 87 per 1,000, respiratory infections, including influenza, pneumonia, scarlet fever, diphtheria, measles, mumps and cerebrospinal fever, and insect-borne infections, such as malaria, yellow fever, typhus and plague.

History of Blood Transfusion

IN a recent thesis (*Thèse de Paris* 1940, No. 344) on this subject, Dr. Edmond Ecale states that the history of the transfusion of blood is intimately connected with the discovery of the circulation. Although even in the prehistoric period the idea of the operation had been conceived, it was in the country of Harvey that the first scientific attempts of transfusion were made, namely, by Christopher Wren in 1656 and Edmund King in 1667. Jean Denis was the first to carry out transfusion from an animal to man in 1667, and was followed a few months later by Richard Lower in England, Riva in Italy and Kaufmann in Germany. Transfusion of blood was prohibited by the Châtelet edict in 1668, and almost fell into oblivion for nearly a century and a half. The first successful transfusion of blood from man to man, which was carried out by the obstetrician James Blundell in 1825, marked an important progress in the history of the method, and was performed with a syringe containing defibrinated blood to prevent coagulation. The introduction, however, in 1879 of intravenous injection of normal saline which was a simpler and safer method interfered with the progress of transfusion of blood for some time. After the beginning of the twentieth century, transfusion of blood was again revived on the discovery of agglutinins, iso-agglutinins, blood groups and blood incompatibilities, which enabled a correct choice to be made of donors and recipients, while the use of anti-coagulants, paraffined tubes and other refinements of technique led to the adoption of the perfected method employed at the present time.

The Long-term Prisoner

In a paper read before the ninety-fifth meeting of the American Psychiatric Association (*Amer. J. Psychiat.*, **96**, 1321 ; 1940) Dr. Marvin Sukov records his observations on thirty men completing life sentences in the Joliet-Stateville branch of the Illinois State Penitentiary. Their ages on admission ranged between 16 and 49, and their ages on examination were between 39 and 73. The study was conducted by means of a questionary in which each inmate was individually interviewed for a period averaging 1¼ hours. Dr. Sukov's conclusions were as follows: (1) Imprisonment was accompanied by progressive social severance, shown by progressive diminution in visits and correspondence in every case. (2) The patients' basic interests with regard to religion, crime and intellectual sphere were little modified by years of imprisonment. None expressed a reduction in alertness except those advanced in age, who attributed it to that cause. (3) Twenty-five who admitted their guilt stated that they had deserved punishment but that their punishment was too severe. (4) While all had a desire for freedom, many had become resigned to life imprisonment and without help would probably be unable to make an extramural adjustment. (5) Nearly all after many years imprisonment showed no antagonism to society, but none could point to a single individual as a friend.

Cave Worship

In an interesting article in the April issue of the *Hibbert Journal*, Dr. R. R. Marett remarks that in addition to its mystic and religious associations the cave played no small part in early medicine, and suggests that it was primarily as a hydropathic establishment that the cave found so much favour with the sick. In the cave of Aesculapius, mentioned by Pausanias, for example, the healing waters gushed out from a rock, and at Elis in the cave of the Anigrid nymphs he states that a leper must sacrifice before bathing in the neighbouring river in order to leave his "shame" there. There were also caves mentioned by Pausanias of which the efficacy had possibly nothing to do with water, such as the cave of Aphrodite. Moreover, the famous Lemnian earth or terra sigillata which was supposed to provide an antidote to snake-poisoning was obtained from a cave.

The Government Museum, Madras

Under the superintendence of Dr. F. H. Gravely, an important extension to the Government Museum, Madras, has been completed and opened to the public, following the plans of the late R. Dann, consulting architect to that Government. The new building has provided accommodation for the staff of curators, the block which they formerly occupied being now given up to the zoological collections. But its main function is to give suitable expression to the evolution of the decorative motives of the architecture of the magnificent temples of South India. For the Tamil country, these changes form an interesting and logical sequence. The temples of other parts of India differ from those of Tamil origin, and although the development of their architecture is not yet fully understood, attempts have been made in the new building to indicate the succession of changes. A short account of these arrangements, based upon Dr. Gravely's address at the opening ceremony, which was performed by His Excellency the Governor of Madras, Lord Erskine, appears in the July number of the *Museums Journal* (40, 109 ; 1940).

Nematode Parasites of Plants

A catalogue of nematode parasites of plants, compiled by Dr. T. Goodey has been issued by the Imperial Bureau of Agricultural Parasitology, St. Albans, price 10*s*. The work consists of an alphabetical list of the scientific names of all plants which have been reported as hosts of nematodes, comprising more than 2,000 species and varieties of flowering plants, 78 ferns, 55 mosses, 5 liverworts and 3 seaweeds. In each case the appropriate parasite or parasites is stated, together with the name of the first recorder and the date of the record. For convenience, an alphabetical list of the popular plant names, with the scientific name appended, is also supplied, so that the reader can be sure of finding the information he requires by whichever plant name is the more familiar to him. The publication concludes with a list of references relevant to the records cited. Usually this is the earliest record obtainable, but in a few cases a more accessible reference has been deliberately selected.

Announcements

The Home Secretary has announced in the House of Commons that he is willing to consider steps to enable alien men of science who are not released to carry on their scientific activities or studies in internment.

The following appointments in the Colonial Service have recently been made: F. R. Bell, veterinary officer, Uganda ; J. H. Hughes, assistant conservator of forests, British Guiana ; R. M. Shackleton, geologist (temporary), Kenya.

A further step in the mobilization of the man-power of Great Britain is marked by the issue of the first industrial registration order made by the Minister of Labour. Registers have already been made of professional engineers, chemists and physicists and quantity surveyors. The new order requires the registration of skilled men more than twenty-one years old in certain specified occupations, mainly engineering, who are not employed on Government work. The five days of registration, to which also the test of full employment on Government work applies, are August 19–23.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Planning the Peace

THE excellent series of articles which have been published in NATURE on the applications of science to social problems encourages me to suggest that specific efforts should be made for planning the peace. It may seem to be an inappropriate time to embark upon this project. I have no wish to distract the attention of those who are actively engaged in the prosecution of the War; but there are others who, by reason of age, physical infirmity, and so on, are doomed to relative inaction. Many such, by virtue of special training, experience, good judgment, and brilliant intellect, might well be encouraged to collaborate in drawing up some indications of the lines which should be followed in the light of their knowledge and appreciation of the grievous errors of the past. At the present time, feelings run high, and the irrational impulses of mob psychology are no sound guide to either the conduct of the War or the making of the peace. It is all the more desirable, therefore, that the restraining influence of level-headed advisers should be marshalled in the interests of sanity.

Presuming that Great Britain emerges successful from the contest, the War will be won; for the demagogic autocracies of Germany and Italy contain within them the seeds of their own destruction, and there can be little doubt that public opinion in the Americas is gradually becoming convinced that the security of the States and the survival of liberty depend upon the victory of Great Britain. It has indeed long been the opinion of many that the survival of civilization, that is, of a corporate life founded on a basis of mutual goodwill, freedom of thought, and Christian ethics, depends upon the co-operation of the English-speaking peoples.

The problems to be considered are of the greatest variety and complexity. The effects of the Treaty of Versailles and the drift into war have demonstrated the blindness of our statesmen to the most elementary facts of individual and social psychology. The psychologist with a biological training is best fitted to explain the causes of war, of which the most fundamental are unhappiness and a sense of grievance. There can be no doubt that there will be a profound change in economic conditions after the War. We may look forward with satisfaction to the abolition of gross disparities in individual incomes; but the levelling process demands the most minute care to avoid the dangers of a communistic revolution. The recent admirable broadcast by the Right Hon. R. A. Butler exemplifies the help which we may expect to receive from the historian and the diplomatist.

Probably the best method of attacking the problem at the present time would be by a series of articles by selected authorities to be published in NATURE or elsewhere.

J. HERBERT PARSONS.

54 Queen Anne Street,
Cavendish Square, W.1.

Identification and Determination of Aromatic Compounds in Mineral Oils

OUT of the many methods suggested[1] for the quantitative determination of the total of aromatic constituents in mineral oils, none is suitable for giving information about the nature of these constituents. In recent systematic research[2] on the aromatization of aliphatic compounds, the method of side-chain oxidation has been used, which, however, is only of value if the number of carbon atoms in the side-chains is known and is not applicable to the fundamental hydrocarbons like anthracene, phenanthrene, naphthalene or benzene.

Ultra-violet spectrography provides an easy method of identifying and determining quantitatively aromatic hydrocarbons in a mixture with substances which show no selective absorption at all, or at least not in the same region as the aromatic hydrocarbons. For the following fundamental hydrocarbons, absorption bands exist which are characteristic, and the intensity of which is directly proportional to the concentration of the hydrocarbons: benzene, toluene, xylene, naphthalene, phenanthrene, anthracene. The bands to be used for their identification are listed in Table 1. The method may be only of limited value in two instances: dialkylbenzenes with identical positions of the alkyl groups but substituted with different alkyls may be indistinguishable; and alkylated polycyclics may exhibit spectra practically identical with those of the parent hydrocarbons. Apart from this limitation, we have been able to identify all the absorption bands observed for those fractions of Iraq petroleum and of a shale-oil of Palestinian origin which distil up to 200° at 0·1 mm. pressure with the bands of the above six hydrocarbons, so that no other constituents of aromatic character are present.

For the quantitative determination of these hydrocarbons, the intensity of the characteristic absorption bands for a given sample is compared, visually or by means of a microphotometer, with the intensity of the same bands for the standard substances in known concentrations. For these comparisons, the substances are either used in solution in (non-absorbent) light petroleum or in the gas phase. With this method, the following figures have been found

TABLE 1.

Benzene	2433,2375 A.
Toluene	2700
Xylene	2713,2739
Naphthalene	3100
Phenanthrene	2932
Anthracene	3570,3760

TABLE 2 (Iraq petroleum).

Benzene content	0·02 per cent
Toluene	0·31
Xylene	0·52
Naphthalene	0·30
Phenanthrene	1·36
Anthracene	1·76

TABLE 3 (Shale-oil)

Benzene content	0·16 per cent
Toluene	0·18
Xylene	3·20
Naphthalene	4·60
Phenanthrene	1·80
Anthracene	1·60

in the case of Iraq petroleum (Table 2) and of the Palestinian shale-oil (Table 3).

The usefulness of the method is evident. It gave information about the interesting phenomenon of azeotropic distillation of aliphatic and aromatic hydrocarbons, which will be studied in greater detail at a later date, and about the aromatization involved in cracking experiments. It may also be noted that the spectrographic method may well contribute to the elucidation of the structure of lubricating oils, which are assumed to be alkylated and partly hydrogenated polycyclic ring-systems; in many cases, dehydrogenation previous to the spectrographic investigation, seems to be useful.

CH. WEIZMANN.
V. HENRI.
ERNST BERGMANN.

Daniel Sieff Research Institute,
Rehovoth, Palestine.
Institute of Physical Chemistry,
University, Liége.

[1] Recently, new methods of the same type have been suggested by A. v. Grosse, *Ind. Eng. Chem.*, Analyt. Edition, **11**, 614 (1939), and by Jostes, *Oel, Kohle, Erdel, Teer*, **14**, 1012 (1938).

[2] Hoog, Verhuis and Zuiderweg, *Trans. Faraday Soc.*, **35**, 993, 1008 (1939).

A Patterson Analysis derived from the Cyclol C_2 Skeleton

I AM grateful to Dr. D. Wrinch for pointing out an error in my previous communication on this subject with Dr. Fankuchen[1]. A check of the calculations showed that our previous Fig. 3 was, in fact, derived from an arrangement of the cyclol molecules with a tilt of 36°, as Dr. Wrinch states[2], and not with a tilt of 6° as we had, by an unfortunate misunderstanding, assumed. This arose from a wrong choice of reference line to define the tilt, suggested, although certainly quite unjustifiably, by Dr. Wrinch's original packing diagram.

I have therefore recalculated numerically the Patterson map obtained by placing the cyclols in the insulin unit-cell with a tilt of 6°, and the essential part of the resulting contour diagram, namely, the triangle between origin peaks, is shown in Fig. 1. The only peak in the field is the large diffuse peak *A*, while *B* is a region of low density. The agreement with the experimentally derived basal Patterson projection of Crowfoot[3], which is reproduced in essentials in Fig. 2, is not very close. The low density region *B* compares with the region *C* in Crowfoot's diagram, but such a large central peak as *A* is not present in the latter case. The experimentally derived Patterson projection has a trigonal arrangement of three well-defined peaks (*B*) around the centre, corresponding to interatomic vectors of 22 A. in this projection. In so far as the peak *A* in Fig. 1 be considered as compounded of three such 20 A. peaks, then it is clear from the calculation that these are due to vectors between the *sides* of the cyclol fabric, and do not arise from vectors between the 'slits' of the octahedron. Approximate working indicated that this central peak *A* would tend to be resolved with an arbitrary tilt of 10° or so. A calculation with $\alpha = 13°$ showed this resolution to be very small, and this tilt also destroys the *B* region of low density. Small deviations from the tilt of 6° therefore do not better the agreement with Crowfoot's projection, and the map obtained with an extreme tilt of 36° has already been discussed. Another unsatisfactory feature of Fig. 1 is the absence of a defined 10 A. peak corresponding to Crowfoot's peak *A*, and a strong 10 A. spacing is a characteristic property of most proteins. I therefore consider that this new derived Patterson analysis is not in nearly sufficient agreement with the experimental data for insulin to afford evidence in favour of the cyclol hypothesis.

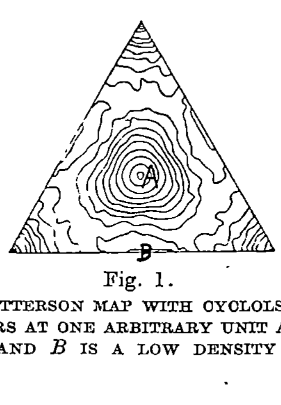


Fig. 1.

DERIVED PATTERSON MAP WITH CYCLOLS AT TILT OF 6°. CONTOURS AT ONE ARBITRARY UNIT APART. *A* IS A PEAK AND *B* IS A LOW DENSITY REGION.

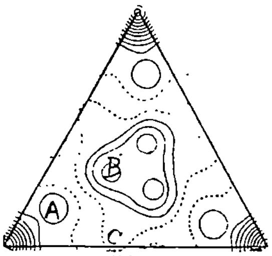


Fig. 2.

EXPERIMENTALLY DERIVED BASAL PATTERSON PROJECTION FOR INSULIN (AFTER CROWFOOT).

In conclusion, I should like to point out that Dr. Fankuchen and myself have never claimed "to have disproved the structure C_2 predicted for the insulin molecule". We were concerned only with investigating the claims by Wrinch and Langmuir[4] of the confirmation of the cyclol hypothesis in the case of insulin by the X-ray data. The work done clearly showed that their primary assumption of approximating the cyclol C_2 molecule by an octahedral arrangement of scattering masses situated at the 'slits' of the cyclol fabric was not even approximately justified. Logically, therefore, their argument was invalidated even without Bernal's criticism[5] or without consideration of the second part of our previous paper or of this communication. I appreciate Dr. Wrinch's criticism of our work on the grounds that only the carbon and nitrogen atoms of the skeleton were considered. Reasons why this should not affect the general validity of the work were given in our paper. In circumstances other than those obtaining at present, it would undoubtedly be most desirable to recalculate the Patterson map having included the oxygen and C_β atoms, in order to settle the matter. In the meanwhile, I would enter a plea for this detailed type of working in comparing any proposed models of protein molecules with the X-ray data, otherwise it is often difficult to separate evidence from speculation.

DENNIS RILEY.

Department of Mineralogy,
Oxford. July 24.

[1] NATURE, **143**, 648 (1939).

[2] NATURE, **145**, 1018 (1940).

[3] *Proc. Roy. Soc.*, A, **164**, 580 (1938).

[4] *J. Amer. Chem. Soc.*, **60**, 2247 (1938).

[5] NATURE, **143**, 74 (1939).

The Generalized Kaleidoscope

A RECENT communication from Sidney Melmore[1] has refuted my statement[2] "that a kaleidoscope cannot have more than six mirrors". The statement should be "that any kaleidoscope is effectively equivalent to one having at most six mirrors". In the case of Melmore's octahedral kaleidoscope, every pattern produced is symmetrical about either of the planes which bisects the dihedral angles of 120°. Hence two extra mirrors may be placed in those positions without affecting the pattern. Six of the eight original mirrors then become superfluous, and we are left with the four faces of the tetragonal bisphenoid[3] *AB'CD'*. The rectangle *BB'D'D* is one half of the common base of Melmore's two square pyramids, with apices *A* and *C*; hence *E* (the mid-point of *AC*) is the point-object which gives rise to the solid tessellation of cuboctahedra and octahedra.

H. S. M. COXETER.

Department of Mathematics,
University of Toronto.
June 7.

Melmore, S., NATURE, 145, 778 (1940).

[2] Ball, W. W. R., "Mathematical Recreations and Essays", 160 (1939).

Op. cit., 159.

I AGREE with Prof. Coxeter's conclusion that no more than six mirrors need be used to produce the solid tessellations. It is now clear that two of his tetragonal bisphenoids, interpenetrating, bear the same relation to my octahedron which two interpenetrating regular tetrahedra bear to the regular octahedron.

SIDNEY MELMORE.

61 Carr Lane,
Acomb, York.
June 24.

Growth of Aggregates in Suspensions

ON reading through the D.S.I.R. report of the Water Pollution Research Board for the year ended June 30, 1938, I was much interested to notice the account of the settling of silt in estuarial waters of the River Mersey. In the course of a study of the effect of sewage upon the rate of sedimentation of mud, it was found (p. 49) that sedimentation occurred only at slack water. The scour during the ebb and flow of the tide erodes fine particles from the bottom so that they disperse more or less uniformly in the water. During slack water, practically the whole of the suspended matter is deposited. It was found that large, fragile aggregates form and then settle at a rate of about 0·011 ft. per sec.

I find that this is approximately the maximum velocity at which these particles obey Stokes's law, that is to say, the settling occurs at the point at which the flow round the aggregate ceases to be wholly streamline. Thus it appears that the mechanism of such settling is that the aggregates continue to grow until their falling speed increases to the point at which the flow becomes turbulent. This prevents further increase of size, so that when full grown their falling speed will be substantially constant.

W. F. CAREY.

Engineering Department,
I.C.I. (Fertilizer and Synthetic Products) Ltd.,
Billingham.
July 11.

Radiation and 'Stuffiness'

IN discussing the spectral transmission of human stratum corneum[1], Messrs. Yarnold and Kirkpatrick have overlooked the measurements of Pearson and Norris[2] which show only a very faint suggestion of the absorption band at 4·1–4·2 μ to which they refer.

In connexion with Yarnold and Kirkpatrick's work on the effect of spectral distribution on the comfort of radiant heat, I may mention that some years ago I measured the time of tolerance of radiation of a fixed intensity falling on a given area of the hand, arm or face, for six subjects. In every case the emission from a 'bright' source such as an ordinary gas fire was tolerated considerably longer than an equal intensity from a box kept at barely visible red heat and filled with coal gas flame.

A. R. PEARSON.

Winfrith,
White Knowle Road,
Buxton.
July 13.

---

[1] NATURE, 146, 62 (1940).

[2] *Brit. J. Radiology*, 6, 480 (1933).

Depression of Neuro-Muscular Transmission in a Crab by Phenothiazine

SINCE phenothiazine is a new and valuable vermifuge, its effect on animal tissues is of some general interest. Its effect on crustacean neuro-muscular function can readily be observed in the shore crab (*Carcinus mœnas*), from which the nerve-muscle preparation is one of the most readily obtainable among invertebrates.

The transmission of excitation from nerve to muscle in the walking leg of the shore crab is characterized by the existence of a natural 'block' at the

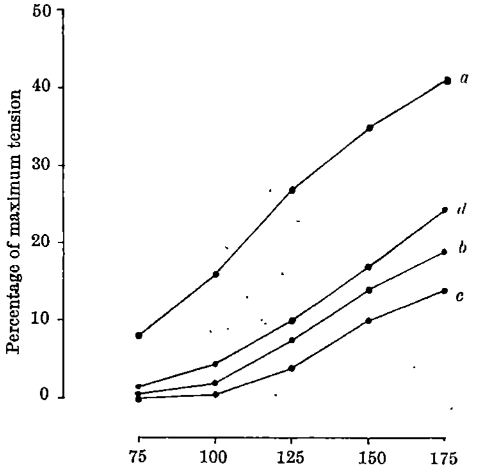


Fig. 1.

PERCENTAGE OF MAXIMUM ISOMETRIC TENSION DEVELOPED AT GIVEN FREQUENCIES. CONSTANT STIMULUS DURATION OF 0·4 SEC.

a, Perfusion with crab's Ringer; *b*, 18 min. after perfusion with 1 part in 5,000,000 phenothiazine; *c*, 11 min. after perfusion with 1 part in 2,000,000 phenothiazine; *d*, 35 min. after return to crab's Ringer.

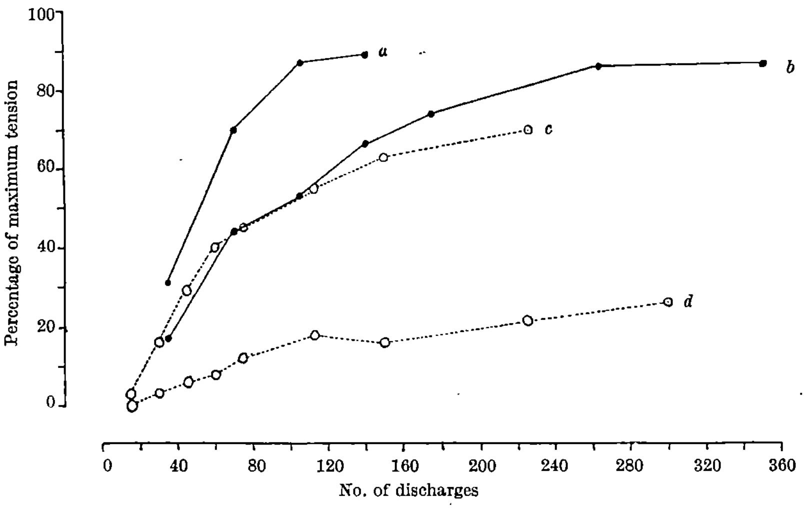


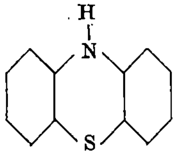
Fig. 2.

PERCENTAGE OF MAXIMUM ISOMETRIC TENSION DEVELOPED AFTER A GIVEN NUMBER OF SHOCKS.

a, perfused with crab's Ringer; 175 shocks per sec.: *b*, perfused with 1 in 1,500,000 phenothiazine; 175 shocks per sec.: *c*, perfused with crab's Ringer; 75 shocks per sec.: *d*, perfused with 1 in 1,500,000 phenothiazine; 75 shocks per sec.

junction, which can be overcome by the summation of nerve impulses arriving there. A just visible contraction of the flexor muscle of the dactylopodite of the walking leg is observed when impulses arrive at the nerve-muscle junction at a frequency of about 10 per sec., while a maximal contraction is obtained at a frequency of about 300 impulses per sec.[1]

Katz has reported that curare does not prevent transmission across the nerve-muscle junction of Carcinus[2]. Increase of junctional 'block' can, however, be effected by concentrations as low as 1 part in 10,000,000 of the vermifuge phenothiazine:



The extent to which junctional transmission is depressed after treatment with a drug can be assessed from several characteristics of the preparation. In the experiments reported here, the nerve was stimulated with a series of brief condenser discharges through a neon lamp. A number of different frequencies of stimulation ranging between 75 and 175 discharges per sec. were employed and the stimulation was applied for measured periods of time. The tensions developed by the muscle were recorded by a spring lever. An indication of the extent to which junctional transmission is depressed after perfusion of the limb with phenothiazine in comparison with the condition when the limb is perfused with crab's Ringer solution can be obtained from a study of the tensions of muscular response at each frequency and duration of stimulation. If neuro-muscular function in the isolated walking leg of Carcinus perfused with low concentrations of phenothiazine (1 part in 1,500,000 to 1 part in 10,000,000) is compared with that in the limb perfused with crab's Ringer solution, it is found that:

(1) The threshold potential for excitation of the nerve is raised.

(2) The maximum tension obtainable from the flexor muscle of the dactylopodite by stimulation of the nerve at high frequency for an indefinite period is little reduced.

(3) Junctional transmission is depressed. If the stimulation is applied for a constant period of time then, during perfusion with solutions containing phenothiazine, a higher frequency of condenser discharge is required to evoke a given tension of muscular response (Fig. 1). If the frequency of discharge is kept constant, then a greater number of discharges is required to evoke a given tension (Fig. 2). The relative extent to which tension is reduced by phenothiazine, moreover, declines as the range of frequencies is ascended (Figs. 1 and 2). The effect of phenothiazine on junctional transmission is partially reversible.

The sample of phenothiazine was kindly given to me by Imperial Chemical Industries, Ltd.

H. O. J. COLLIER.

Department of Physiology,
The University,
Manchester.
July 3.

---

[1] Pantin, C. F. A. (1936), *J. Exp. Biol.*, **13**, 111.

[2] Katz, B. (1936), *J. Physiol.*, **86**, 14*P*.

Mixed Radioactive Indicators in Physiological Experiments

OBJECTIONS have been raised against the use of radioactive indicators in physiology, suggesting two sources of error, namely, a discriminating effect for isotopic atoms, and a change in the behaviour of organic material through irradiation[1]. Although one has good theoretical reasons to believe that the radioactive tracer atoms and their non-active isotopes show the same physico-chemical behaviour[2], and that effects of irradiation could be neglected so long as the specimens are not too active[3], it has been emphasized[2] that doubts about the tracer method can only be removed by experimental evidence.

The property of biological material of discriminating between the radioactive and non-active isotopic atoms represents only a special case of the separation effect of ordinary isotopes in biological tissue[4,5]. This question could be easily examined, in some cases at least, by the use of two or more active isotopes of the same element. If the proportion of these before and after the experiment were the same, then no isotope separation can have taken place. On the other hand, any differentiation can be measured quantitatively. This is only possible with some elements, and is unfortunately not possible with the biologically important phosphorus and sodium, but the general question of biological separation could be accurately investigated with such elements as calcium, iodine, bromine, silver, etc.[6]

The effect of irradiation on tissues could be examined by observation of the amounts absorbed of a solution activated with a suitable tracer element, before and after exposure to the same solution 'tagged' with a different active isotope.

OTTO BLÜH.

Department of Physics,
The University,
Edgbaston,
Birmingham, 15.
July 19.

---

[1] Barnett, A., *Phys. Rev.*, **56**, 963 (1939).

[2] Crane, H. R., *ibid.*, **56**, 1234 (1939).

[3] Mullins, Lorin J., *ibid.*, **56**, 1244 (1939), Hevesy, G., *ibid.*, **57**, 240 (1940).

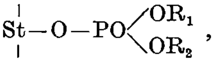
[4] Brewer, A. Keith, *Ind. and Eng. Chem.*, **30**, 893 (1938).

[5] Lasnitzki, A., and Brewer, A. K., NATURE, **142**, 538 (1938).

[6] Livingood, J. J., and Seaborg, G. T., *Rev. Mod. Phys.*, **12**, 30 (1940).

Influence of Combined Phosphoric Acid on the Swelling of Granular Starch

IN some starches phosphorus occurs in combination as a salt of an amylomonophosphoric ester[1],



$$\mathrm{St{-}O{-}PO}\begin{matrix}\diagup OR_1\\ \diagdown OR_2\end{matrix}$$

, where St is a glucose unit in the polysaccharide chain and R_1 and R_2 are metal or hydrogen atoms; in others the phosphorus is not combined with the starch, and part of the phosphorus-containing impurity can be removed by extraction with methanol or cold dilute mineral acid. Potato and wheat starch are representative of the two classes[1].

The metal combined with the phosphorus in potato starch can be varied by washing with appropriate salt solutions and then with water until the filtrate is free from electrolyte[2]. The properties of the washed starch vary with the identity and amount of the combined metal; for example, the swelling capacity of the granules in hot water and the viscosity of the hot 3 per cent paste of a sodium starch are greater than those of the corresponding calcium starch. The difference is not observed in presence of salt and is probably due to the greater tendency of the sodium to ionize and diffuse into the surrounding water. It was expected that after washing with the same salt solution the swelling behaviour of potato starches would be related to their phosphorus contents provided that their average molecular chain-lengths[3] were the same. No simple correlation has been found, however, in a group of eight starches that satisfy this condition and contain 0·145–0·232 per cent phosphorus pentoxide. The swelling capacities in salt solution of the samples differ considerably so that there may be differences in sub-microscopical structure which mask the effect of the phosphorus on the swelling in pure water.

The phosphorus contents of fractions of uniform granule size separated by elutriation in water from one sample of potato starch increase with decreasing mean radius. The copper-reducing powers, specific viscosities in 30 per cent calcium thiocyanate solution, and the solubilities of the fractions in 0·01 *M* phosphate buffer solution, *p*H 7, are almost identical and the differences in swelling capacity in the same buffer solution are small; it may be concluded, therefore, that their average chain-lengths are the same and that the structure factor is common to all. In distilled water, swelling is much higher than in salt solution, and among the sodium starches prepared from the different fractions the swelling increases three-fold as the phosphorus pentoxide content increases from 0·148 to 0·254 per cent (see accompanying table). These differences in swelling are not due to differences in the ratio volume/surface area of the granules[4], since fractions 1 and 2, differing in average radius but nearly equal in phosphorus content, swell equally.

On the other hand the swelling of the fractions from a wheat starch is independent of granule size, phosphorus content, the salt used in washing, or the presence of salt during swelling. It is therefore evident that esterified phosphoric acid does facilitate the swelling of starch granules to an extent dependent upon its amount, but the effect is manifest only in the absence of free electrolyte and when the average chain-length and the structure of the granules are the same.

	Potato Starch						Wheat Starch		
Fraction	1	2	3	4	5	6	1	2	3
Percentage by weight	0·7	7·1	39·4	12·4	32·5	6·8	18·5	64·0	17·5
Average radius * of the granules (cm. × 10^4)	5·9	8·5	13·8	19·1	25·5	29·3	3·8	8·1	11·1
P_2O_5 per cent	0·254	0·244	0·195	0·169	0·153	0·148	0·130	0·114	0·115
Swelling capacity † at 70° (potato) or 85° (wheat). c.c. water/gm. of undissolved starch:									
Na starch	150	151	104	68	62	55	16	19	16
Ca starch	49	52	54	48	40	47	15	19	16
Na or Ca starch in salt solution	25	24	23	20	20	19	16	17	16

* by a photographic method.
† determined by centrifuging a 0·3 per cent suspension under standard conditions after attainment of equilibrium.

Enhanced swelling has also been observed when carboxylic acid groups have been introduced by oxidation into a granular starch of low phosphorus content.

W. A. RICHARDSON.
R. S. HIGGINBOTHAM.

Shirley Institute,
Didsbury,
Manchester.
July 22.

---

[1] Posternak, *Helv. chim. Acta*, **18**, 1351 (1935).

[2] Tryller, *Chem. Z.*, **44**, 833, 845 (1920).

[3] Richardson, Higginbotham and Farrow, *J. Text. Inst.*, **27**, T131 (1936).

[4] Alsberg, *Ind. Eng. Chem.*, **18**, 190 (1926).

RESEARCH ITEMS

South African Stone Bead Industry

The relative scarcity of the stone bead throughout the world justifies a record of the discovery of serpentine beads by Harold S. Harger on sites in the western Transvaal (*Trans. Roy. Soc. South Africa*, 38, 2 ; 1940). From the collection as a whole it has been possible to describe the entire process of manufacture from beginning to end. The prime factor in the establishment of the industry was the occurrence of a serpentine dyke midway between the factories on Nooitgedacht and Winkelhaak. This region affords abundant evidence of settlements of primitive man of pre-Bantu times. The serpentine beads were found in cleared spaces where native kraals at one time had existed. Old furnace slags, an iron hammer, ornamental stone pendants, gold beads, a steatite mould, pottery, etc., combine to indicate that the industry was established by an early Bantu tribe in pre-European times. The greater part of the material consisted of 108 cylinders ready for boring, 15 were finished ready for use ; and 15 beads of copper and 2 of gold were also found, the occurrence of the last named indicating a Bantu origin. Some much-corroded pieces of iron found on Winkelhaak, when fresh, might have been thin enough to perform the boring. One bead had been bent to take the palm of the hand and facilitate vertical pressure. The procedure adopted in manufacture was to trim the material into cylindrical shape and then saw it in sections—a method followed by Cro-Magnon man in the manufacture of stone beads. The segments were then drilled and smoothed, the ends being ground smooth on a stone to make them lie close. To avoid waste of labour owing to splitting in drilling, stones were sometimes drilled before shaping. While the industry is early and pre-European, it is Bantu and not, properly speaking, Stone Age, as usually understood.

The Fishing Heron

Considerable controversy over the heron's diet has long passed between anglers and fish conservators on one hand, who claimed the large proportion of fish in the bird's menu, and bird protectionists on the other, who brought forward the results of pellet and other investigations which showed a preponderance of frogs, voles and other small waterside vertebrates. The argument will now probably be cleared up following the work of Miss A. Hibert-Ware, of Hilary, Girton, Cambridge, who, with the help of others, has collected 270 pellets from Norfolk, Carmarthenshire, Surrey and Cambridgeshire, and found numerous remains of small vertebrates and insects in them, but only remains of the dace among fish, despite the observations on the abundance of eels and coarse fish brought to the heronry nests. Subsequent studies of the digestion of the heron (*Ibis*, July 1940) suggested that fish figure more prominently in the diet than previous food investigations show, and the strong digestive juices and the soft, non-grinding nature of the gizzard leave little opportunity for remains to be ejected in the food pellets. These pellets were found to be strongly acid when fresh. The chief remains noted in the pellets were moles, water voles and Dyticus and Colymbetes insects. Mammalian food also included small specimens of rabbit, water-shrew, and brown rat ; bird remains included starling, redbreast, moorhen, coot, mallard, wood-pigeon and poultry chicks ; reptiles included slow-worm, grass snake and adder ; frog was the only amphibian ; there were also remains of the water-boatman bugs (Corixa and Notonecta) and the water-beetle Hydrophilus ; but a few remains of earwig, grasshopper, wood-lice, spiders and carabids or ground-beetles suggest that these were taken in the other prey consumed.

Birds on St. Kilda

St. Kilda was evacuated in 1931, and, except for the summer visits of a few of its former inhabitants, has run wild since that time. With the deliberate intention of founding a basis on which future comparisons might be based, T. H. Harrisson and David Lack made in 1931 a census of the birds on the island, and a new census by E. M. Nicholson and J. Fisher made in 1939 offers the first comment on changes induced by the absence of man (*British Birds*, 34, 29 ; 1940). The majority of the birds, land or sea, show no significant change, a specially noteworthy fact in the case of the gannet and fulmar petrel, considering the allegations that have been made regarding the destructiveness of man in relation to these birds. The black guillemot seems to be disappearing, only one individual having been seen in 1939, whereas six pairs were noted eight years before. On the other hand, shags and razorbills have increased, as has also the meadow-pipit. Striking additions to numbers were observed in the case of starlings, attributed to the supply of undisturbed nesting sites in the deserted houses and to the abundance of sheep ; of eider duck, attributed to the freedom from egg-robbing ; and of the common snipe, which curiously enough have colonized the enclosed dry fields about the village and were more frequent there than in the marshy haunts of the island, their normal habitat.

Indian Chalcid Wasps

Miscellaneous Bulletin 30 of the Imperial Council of Agricultural Research (India), by Hem Singh Pruthi and M. S. Mani, contains biological notes on Indian parasitic Chalcidoidea. It is in the main a host list referring to 175 species of these insects—the phytophagous forms of Chalcids, it may be added, are not included in this bulletin. Some fifty-six of the species dealt with are figured on the accompanying plates. From the list at the end of the bulletin it will be gathered that the Rhynchota feature as the most frequent hosts for these parasites, the Lepidoptera coming second in this respect. The insect collections in the Laboratory of the Imperial Entomologist contain a large amount of material, with data, concerning insect parasites. Information derived from this and other sources is being worked up and made available to workers in India and other countries. It is intended to publish the data so obtained, taking one group of parasites at a time. The series has been started with the present host-parasite account of the Indian Chalcids, concerning which no information has been available in comprehensive form at present.

Crinoids from the "Discovery" Expedition

D. Dilwyn John has beautiful material to describe, consisting entirely of Comatulids from the "Discovery" expedition (Crinoidea, *Discovery Rep.*, 18, 121–222; 1938). There are 326 specimens, mostly from depths between 100 and 600 m., 269 from the Antarctic region, the majority from the South American sector, a small number from the Ross Sea. 54 are from the Burdwood Bank and the Patagonian Shelf and are all of one species, *Isometra vivipara*, common to that region and to the Antarctic. The other 3, all *Comatula novæzealandiæ*, are from New Zealand. 9 species of the family Antedonidæ are new. A feature of the collection is the number of species which care for the brood and are viviparous. Most Comatulids shed their eggs directly into the sea and only 3 viviparous species were previously known, 8 more are now added, 6 belonging to new species and a new variety, and 2 which were not before recognized as being viviparous, making 11 viviparous Comatulids now recorded, 8 of which have only been obtained from the Antarctic. Out of 19 species known from the Antarctic 50 per cent are viviparous. A gradual series is shown in the methods of brood protection, from those with numerous eggs and larvæ with ciliated bands presumably emerging in the free-swimming stage to those with very few eggs which retain the young in the brood-pouch until the Pentacrinoid stage or, in one case, even as far as the young Comatulid. In all the viviparous species there is in the female a brood-pouch beside each ovary.

Maternal Constitution and Infant Mortality

An extensive analysis of the morphology of mothers and the mortality of their infants up to one year old has been made by H. C. Seibert (*Human Biol.*, 12, 232–246; 1940). Those mothers whose infant had died were significantly shorter in mean stature at exterior auditory canal, at suprasternal notch, and at lower costal margin and in mean sitting height, but not in mean trunk height. Body weight, span, head-length and -breadth, mean bia-chromal, bi-iliac hip and sagittal chest diameters were not significantly different in mothers with and without infant mortality. Several physiological phenomena were found to be uncorrelated with infant mortality.

Genetics of the Fowl

F. B. Hutt and W. F. Lamoreux (*J. Hered.*, 31 231–235; 1940) publish a map of the chromosomes of the fowl, involving six linkage groups and 21 mutant genes. With the exception of the sex chromosome, it is as yet unknown which of the 40 chromosomes bear these linkage groups.

Structural Changes in the Chromosomes of Drosophila

H. J. Muller (*J. Genetics*, 40, 1–66; 1940) has made an intensive analysis of the phenomenon giving rise to structural changes in the chromosomes of Drosophila. The genetically observed rearrangements are secondary effects to the primary changes brought about by irradiation. The frequency of these observed effects varies as the 3/2 power of the total dose for the range 1,000 r.–4,000 r. At lower doses the observed exponent rises nearly to the square, indicating that nearly all the rearrangements represent combinations of independent primary changes. There is little effect of temperature, wave-length or duration and intensity upon the frequency change brought about by irradiation. Therefore, change is caused by individual ion-effects which act separately. The 3/2 power relationship is accounted for by the survival value of the secondary changes and by the occurrence of unidentifiable multiple rearrangements. The author therefore brings forward strong evidence that 'breakage followed by union' as distinct from 'previous contact' is the phenomenon which gives rise to the observed chromosome rearrangements and other chromosome mosaics. Related work and theories are discussed.

Crystallization of Olivine-basalt

The Hat Creek basalt flow, north of Lassen Peak, California, has been described by C. A. Anderson (*Amer. J. Sci.*, 477–492; 1940). The lava was erupted along a line of north-south fissures, probably within the last two thousand years, and although it is holocrystalline for the most part, with an ophitic to sub-ophitic texture, it possesses many characters indicating marked fluidity at the time of eruption, for example, lava tubes, ropy pahoehoe surfaces, pressure ridges and slump scarps. It is shown that the Hat Creek basalt is of essentially the same composition and texture as the widespread Pliocene Warner basalt which covers a large area of north-eastern California, where it forms the major part of the Modoc lava plateau. The rock is rich in alumina and magnesia, and the history of crystallization is shown to be simultaneous separation of olivine and plagioclase, followed by pigeonitic pyroxene, plagioclase and iron ores. If chilling is rapid, hyalopilitic, intersertal or intergranular textures result from basaltic magmas of this composition, but with slower cooling, sub-ophitic textures develop with local areas of ophitic (poikilitic) texture. On the other hand, in plateau basalts of tholeiite type olivine is absent or rare and the lower amount of alumina results in a smaller proportion of felspar, so that the magma begins to crystallize near the boundary surface of the pyroxene and plagioclase fields and simultaneous crystallization of these minerals soon follows after the initiation of crystallization.

Upper Palæozoic Floras and Climates of South America

At the Eighth American Scientific Congress held in May 1940, several papers were presented dealing with the floras and climates of South America in Upper Palæozoic times. C. B. Read well summarizes present knowledge of the floras. The little that is known of the Devonian floras suggests identity with those of the northern hemisphere. Similarly, the Lower Carboniferous assemblages known from Peru and Bolivia show a very striking relationship to those of certain stages in the Mississippian of North America and the Lower Carboniferous of Europe, as well as to those of the Kuttung series of Australia and the Po series of India. The occurrence of Glossopteris floras and their relationships to tillites in the Falkland Islands, Argentina and Brazil is discussed. The general succession appears to be one in which the earliest floras are few in genera and species and completely austral. This is followed by larger associations in which distinct boreal elements appear. There appears to be a considerable body of evidence favouring a Carboniferous rather than a Permian age for these older Glossopteris floras and, in consequence, for the subjacent 'Gondwana' tillites.

M. de Oliveira Roxo discusses the habitat of the plant remains found in the coal-bearing deposits of South Brazil. He arrives at the conclusion that the plants flourished in a climate similar to that of the southern part of New Zealand at the present day, a climate that favoured the growth of a mixed flora with both cosmopolitan and 'Gondwana' types. In another paper the same author states that 17 species of 'Gondwana' plants, 8 of which are peculiar to Brazil, and 12 species of cosmopolitan plants have so far been identified.

A Seismograph for Microseisms

WITH the aid of a small research fund given by friends in St. Louis, U.S.A., it has been possible for the Department of Geophysics of St. Louis University to build a comparatively simple and relatively inexpensive seismograph especially for the study of microseisms. The instrument was designed by Rev. J. B. Macelwane, S.J., and built by W. F. Sprengnether (*Trans. Amer. Geophys. Union*, 1938). The design chosen was a small horizontal pendulum with tension-hinge supports, induction transducer, and electromagnetic damping. The relatively small dimensions and slight moving mass of only about two and one half pounds make the instrument readily portable. The boom of aluminium tubing carries a brass frame into which is set a brass box containing the two coils wound with a large number of turns of fine wire. This coil box is supported in the field of a strong horse-shoe magnet of Alnico alloy, and the wires are led back through the hollow boom to binding posts on the frame. At the outer end of the boom is a copper damping vane which moves in the fields of four opposing pairs of small commercial Alnico magnets, the separation of which may be adjusted to secure critical damping at any period desired. The current from the coils of the transducer is led to a Leeds and Northrup type *R* galvanometer of seven seconds period, the critical resistance of which is that of the coils in series. The period of the pendulum is adjusted to seven seconds, so that the whole system is in resonance with the microseisms that are to be studied. The results have been very gratifying, and excellent records are obtained with the magnification adjusted to about five thousand.

Reactions between Dry Salts

REACTIONS between the alkali halides in the solid state have been studied by H. L. Link and L. J. Wood (*J. Amer. Chem. Soc.*, 62, 766; 1940), mixtures of salt pairs being heated for long periods of time below the fusion point and the resulting mixtures analysed by the X-ray method. If the pair of salts containing the heavy cation united with the heavy anion and the light cation united with the light anion is called the stable pair, and the other mixture the reciprocal pair, then evidence for the partial or complete conversion of the reciprocal to the stable pair was obtained for forty out of forty-two reactions examined. Except in the mixtures containing lithium salts but no fluorides, no tendency for reversal of the stable to the reciprocal pairs was noticed. It was found in general that there was very little reaction in the solid state if the reaction temperature was more than 200° below the melting range, and that there was likely to be considerable reaction if the reaction temperature was within 100° of the melting range.

Organic Compounds of Tungsten

VARIOUS attempts have already been made to prepare organic compounds of tungsten, but with little success. The possibility of the existence of such compounds was, however, rendered very likely by the preparation of organic compounds of chromium, and later of molybdenum. Bearing in mind the types of chromium and molybdenum salts which were used in the successful preparation of their organic compounds, F. Hein and E. Nebe have now obtained similar compounds of tungsten (*Naturwiss.*, 28, 93 ; 1940). The best starting materials are non-electrolytic complexes of the type $[MeX_3A_3]$ and pseudo-salts of the type $[MeX_n]$. Tungsten hexaphenate, described by Funk (1936), was found to combine readily with phenyl magnesium bromide, forming a brown substance. This resembled in appearance the organic molybdenum compounds. Analogous compounds were obtained by the reaction of tungsten hexachloride and Grignard reagents or lithium phenyl. $(C_6H_5W)_2O_7H_4$ and $(C_6H_5)_3W_2O_8H_7$ have been isolated. In colour and reactions they resemble the corresponding molybdenum compounds. Like them, they are less stable than the organic chromium salts.

Apparent Places of Fundamental Stars

IT was recommended at the International Astronomical Union held in Paris in 1935 that the apparent places of stars in all astronomical ephemerides should be based on the mean places of the Third Fundamental Catalogue of the "Berliner Astronomisches Jahrbuch", known as FK3. It was further recommended that, from the date of the adoption of the star places of the FK3, the apparent places of the 1,535 stars in the FK3 and its supplement should be published annually in a single volume, under the auspices of the I.A.U. The first volume is now available (London : H.M. Stationery Office. 30*s*. net). Its preparation has been shared by the co-operation of the national almanac offices in Berlin, Paris, San Fernando, Washington and London. The computations of the apparent places of the stars have been shared by the first four, while Great Britain has been responsible for the collation and preparation of copy, independent checks and proof reading, and the British Government has borne the cost of printing. The 1,535 stars for which mean and apparent places are given consist of 853 10-day and 20 circumpolar Auwers' stars, and also 630 10-day and 32 circumpolar additional stars. In the reductions to apparent place, the constants of precession, nutation and aberration involved are those adopted by the Conférence Internationale des Étoiles Fondamentales, which met in Paris in 1896. The details relating to the numerical values and methods of reduction are given in each of the five almanacs issued by the countries participating in the work. The introduction is printed in English, French, German and Spanish, and full explanations are afforded of the various sections under mean places of stars, apparent places of stars, short-period terms of nutation, etc. There is an index to apparent places of stars which enables the page upon which the apparent place of any star is tabulated to be found from a knowledge of the star's name alone, and all names given to stars in the work are included in the index, which is, therefore, very complete. It is satisfactory to know that the recommendation of the I.A.U. regarding co-operation in the production of this volume has proved possible.

GRAIN DESTRUCTION BY INSECTS

BY DR. A. D. IMMS, F.R.S.

THE Department of Scientific and Industrial Research has recently published a report* dealing with the infestation of stored grain by insect pests. The survey which it describes was undertaken at the request of the grain trade and with its help and assistance towards the cost. The survey was carried out by the Department of Zoology and Applied Entomology of the Imperial College of Science under the direction of Prof. J. W. Munro. In order to maintain proper liaison with industrial concerns a Standing Conference was set up, under the chairmanship of Mr. W. McA. Gracie of the L.N.E.R. Co., to act as a consultative body. A Technical Consultative Panel, representative of many aspects of the problem, also established to make this knowledge available for the benefit of the investigation. Also, in order to assist the scientific workers engaged on the survey, a Grain Infestation Survey Committee was set up under the chairmanship of Sir Edwin Butler.

The field work of the survey has lasted about a year. Its most important result is the demonstration that infestation occurs throughout all the industries producing, housing, transporting, trading in, manufacturing, or using cereals and cereal products. No single industry, therefore, is in a position to accuse another as being the source of the prevailing evil. Compared with the elaborate series of processes used for the cleaning, conditioning and refining of flour, the prevailing methods of storage are almost crude.

The major problems appear to be the regulation of humidity and temperature. Until the causes of the rise in these two factors, as affecting stored grain, are better understood, effective regulation is not attainable. This aspect of the subject is a complex one and one which involves time for its solution. Meanwhile palliative measures for reducing and controlling infestation need to be considered. The survey has proved its value in recognizing and defining the main problems that need to be tackled. Good ventilation, general cleanliness, segregation of infested consignments and other simple methods of control have yielded results of value. Hygienic measures alone, however, will not provide sufficient control while heavily infested imported cereals and cereal products are brought into Great Britain.

The problem of insecticidal treatment comes to the fore; but there are real difficulties and disadvantages involved by their application. The importation of infested grain, as is continually going on, offers little encouragement to the dock authorities to provide modern hygienic transit vehicles and storage capacity. Also, unless these conditions are available it is unreasonable to expect the exporters to ensure freedom of their cargoes from infestation. In other industries the question whether the importing or exporting parties shall take first action has resulted in a stalemate except in one section of the dried-fruits industry. Timely measures by the Board concerned have resulted in a wholly negligible infestation of Australian dried fruits on the home market during the past five years. The way is thus pointed towards the reduction of one of the major evils of grain infestation.

The insects infesting grain are not natives of the British Isles: they cannot live and breed in our climate in the open, but only in barns, granaries, warehouses, mills, etc. The links in the chain of distributing infestation begin with the arrival of vessels from overseas and go from them to dock premises, vehicles and containers, and so to mills, merchants, breweries, maltings, farms, etc. The report has done good service in stressing the risks and formulating the problems that have to be met at a time when food conservation is of paramount importance. Also, as a beginning, the recognition of proper cleanliness and the separation of infested from clean grain are steps in the right direction. Since there is a whole chain of circumstances requiring control we have to bear the burden of neglect of applied biology at a time when the nation is facing its greatest crisis.

---

* "Report on a Survey of the Infestation of Grain by Insects" (London: H.M. Stationery Office, 1940). 1s. 3d.

EARLY EXPLORERS OF SOUTHERN SOUTH AMERICA FROM THE UNITED STATES*

BY COLONEL LAWRENCE MARTIN,

DIVISION OF MAPS, LIBRARY OF CONGRESS

IN October 1829, Capt. Nathaniel Brown Palmer, who had discovered the mainland of Antarctica nine years earlier, sailed from New York in the brig *Annawan* and Capt. Benjamin Pendleton sailed from Stongington, Connecticut, in the brig *Seraph*. With them travelled five scientific investigators, Dr. James Eights of Albany, N.Y., Dr. John Frampton Watson of Philadelphia, Pa., Mr. Jerimiah N. Reynolds of Wilmington, Ohio, and two associates whose names are not known. These five were, as it seems, the first persons from the United States of America who carried out scientific investigations and inland explorations on the continent of South America. The captains of the two brigs independently explored the waters, largely uncharted, between South America and Antarctica.

---

* Abstract of a paper presented to Section VIII (History and Geography) of the Eighth American Scientific Congress.

Eights of Albany is the great name in the group. He was a physician and an accomplished naturalist, being well equipped in geology including glaciology, and highly competent in botany and zoology as well. The scientific investigations by Eights commenced in the south-east of the Argentine, where he landed at several places on the east coast of Patagonia in January 1830. He collected, *inter alia*, a crustacean, which he called *Brogniartia trilobitoides* and which is now known as *Serolis trilobitoides* (Eights), and also a plant afterwards identified as *Adesmia candida* by Hooker.

In the Isla de los Estados, or Staten Island, south-east of the Straits of Magellan, Eights continued scientific collecting. Here the botanical results included the plants *Viola Magellanica*, *Stellaria debilis*, *Galium Antarcticum*, *Senecio Eightsii*, *Clarionia Magellanica*, and *Pratia repens*. Doubtless some of these names have been modified in modern botanical practice.

In extreme southern Chile, upon islands near Cape Horn, Eights pursued his botanical and zoological studies shortly after January 22, 1830. A previously unidentified isopod, described as being found in unusual abundance in pools left by receding tides, was *Sphæroma bumastiformis*.

Eights' principal geological studies were carried out in the South Shetland Islands, an archipelago much nearer to Antarctica than to South America. Here he spent the month of February 1830. He was the first professional geologist to say "let [Antarctica] rocks their silence break". He showed that the South Shetlands were underlain by argillaceous conglomerate and sandstone, dipping south-east at angles of 12°–20°, intruded by basalt, and with carbonized wood in the conglomerate. Among recent plants, he found *Usnea fasciata*, *Aira Antarctica*, some species of Polytrichum and of Avena, one or two lichens, and a marine Fucus.

The sea life included two new species, *Glyptonotus Antarcticus*, and *Decolopoda Australis*, a 10-legged red sea spider, to say nothing of the more familiar fur seals, elephant seals, sea leopards, whales, porpoises, etc. Eights identified at least sixteen species of South Shetland birds besides five species of penguins. He worked out the regime of the South Shetland tides, finding only one ebb and flow every twenty-four hours in most localities, and studied the ocean bottom deposits.

The substantial geographical contribution of Captains Palmer and Pendleton in 1829–31, aside from taking the investigators to the places where they worked in the Argentine, the South Shetland Islands, and Chile, was their demonstration that no oceanic islands are to be found south-west of South America along the particular courses independently traversed by the two brigs. A logbook in the Library of Congress, that of the schooner *Penguin*, a consort of the *Annawan* during the voyage from Staten Island to the South Shetlands and on to the Island of Mocha in Chile, contributes to meteorology, oceanography, and ornithology by indicating (1) directions and forces of the wind day by day, (2) days when there was rain or sleet, (3) presence or absence of icebergs and other sea ice, and of floating kelp, (4) distribution of penguins and other oceanic birds. During the six weeks voyage of Capt. N. B. Palmer and his brother Alexander in the South Pacific, they sailed some 3,500 miles between February 20 and April 3, 1821, starting from Potter's Cove in the South Shetlands, continuing to a point in the ocean near lat. 58° 01′ S. and long. 103° 03′ W., and ending at the Island of Mocha south of Concepción, Chile. Watson and Reynolds sailed westward on the *Annawan* with Capt. Palmer.

Eights anticipated Charles Darwin by some nine years in observing glacial boulders carried in or left by floating icebergs and deducing from them the geology of unvisited lands poleward from the points of observation in the South Pacific Ocean and in the Shetland Islands. He probably sailed from this archipelago about March 1, 1830, in the *Seraph* with Pendleton and reached Chile early in May, after exploring south-westward and westward from the South Shetland archipelago in the waters between lat. 60° and lat. 70° S. and long. 54° and long. 101° W. By convincing deductions from two months of collecting meteorological, oceanographical, zoological, and botanical data, including facts about the prevailing winds, the fogs, snow, sea ice, icebergs with rocks in them, ocean currents, kelp, penguins, terns, and so on, he established the existence of a long stretch of unseen land. He thought it to be insular, that is an extensive chain of islands, but it was actually a portion of the antarctic mainland west of the Palmer Peninsula, a part of the *terra incognita* which Admiral Richard E. Byrd mapped by aeroplane flights from the *Bear* in 1940.

In Southern Chile, where the *Seraph* and the *Annawan* operated together during 1830–31, Eights presumably continued his geological, botanical, and zoological studies, chiefly in the lands adjacent to the Chonos Archipelago, the Gulfs of Ancud and Corovado, the Island of Chiloe, and adjacent islands and waters. Reynolds and Watson, landed by Pendleton and Palmer at the mouth of the River Arauco on July 23, 1830, spent four months or more in the interior of the so-called Araucania, exploring the lands, investigating the resources, and studying the native people. They brought back thirteen chests of scientific specimens which were placed in the Lyceum of Natural History at New York City, and two chests which were given to an institution at Philadelphia, Pa. Reynolds presented to the Boston Society of Natural History in Massachusetts a substantial collection of ornithological, botanical, marine, and mineralogical specimens, not only from the South Shetlands and Chile but also from Peru and the Galapagos Islands as well. Fragments of Eights' herbaria are in the State Herbarium at Albany, N.Y., other portions being with the collections of Sir Joseph Dalton Hooker in England. His geological and zoological specimens, and his field notebooks, have not been discovered.

These explorations and scientific studies in the southern parts of the Argentine and Chile, and in adjacent islands and waters, resulted indirectly from a message which John Quincy Adams, President of the United States of America, sent to the Senate and House of Representatives on December 6, 1825, only five years after the discovery of the antarctic mainland by Palmer. If Pendleton and Palmer had not taken Eights and Watson and Reynolds in 1829–31 to the localities alluded to above, there might never have been a United States Exploring Expedition of 1838–42 under Admiral Charles Wilkes. Eights' field-work in Patagonia and Isla de los Estados in the Argentine, and near Cape Horn in Chile, is one of the very early professional scientific investigations in the coastal regions of South America, as well as in the South Shetland Islands and South Pacific Ocean not far north of Antarctica, by a technically qualified scholar from North America.

TAXONOMY IN THE JUNGLE

BY PROF. JAMES RITCHIE

THE naming of species and their subordinate groups in laboratories and museums is a familiar process; indeed, it is the process by which the vast majority of animals have been named from the time of Linnæus onwards; and it has performed with reasonable success its two main objects, of labelling for convenience the population of the world, and at the same time of expressing degrees of natural relationship. But the demand for more precise methods of delimiting species is often made, and this demand takes two distinct trends, both influenced by the knowledge that species are not self-contained units but are composed of individuals the characters of which intergrade with those of related species. On one hand there is the plea for a statistical analysis of the morphological characters of populations before the risk is taken of dubbing a new species, as in Ginsburg's 'arithmetical definition' which expresses numerically intergradation or divergence. On the other hand there is a growing tendency to interpret characters in relation to environment, so that relatively small morphological differences which are constant throughout a habitat are regarded as of taxonomic significance.

There is no reason why the two methods should not be combined, each making its contribution to the validity of the final definition; but it must be recognized that for a vast part of the animal kingdom, as it is named, both methods would have been impracticable, the first because it demands large series of closely related forms, the second because it requires intimate knowledge of habits and restricted habitats. Had the *Challenger* collections awaited such refined tests, the systematic zoology of the ocean would have lost a foundation which on the whole has turned out to be solid and reliable.

On land the method of ecological taxonomy is more easy to apply than in the sea, unless it be on the shore and in the region between tides, and a close analysis of vegetation zones and of the peculiar characteristics of their inhabitants is bound to reveal unexpected affinities. A good example of this kind of analysis is Ivan T. Sanderson's account of "The Mammals of the North Cameroons Forest Area"[1]. It is true that the author minimizes the amount of study already done on these lines, for it is scarcely accurate to say that "within areas that may be defined as zoogeographical provinces little work has been done upon the distribution of animals" (p. 630) when one considers-- to mention a few—the investigations of Beebe, Hingston and others in the Amazon region, of Grinnell and Storer in California, the many American contributions to zonal distribution published particularly by the American Museum of Natural History (including one dealing with an area not far distant from Mr. Sanderson's chosen spot, Chapin's "Birds of the Belgian Congo", part I of which ran to 900 pages), and that even the knowledge of the animals of our own islands has been closely linked with habitats. But the author enters with the zest of a pioneer upon his inquiry, and has carried it out with such thoroughness that it will serve as a model for the zoologist in the tropical forest.

The place selected was the Mamfe Division, inland from Calabar, containing one of the largest remaining areas of unaltered primary rain forest in the whole of West Africa and including many contrasting ecological situations. The method of collecting was unusual: first a map-survey of the whole territory was made; then specimens collected in any ecological unit of the survey were examined and their appearance in the flesh recorded, with no attempt to name them by orthodox taxonomic standards. Indeed, instead of 'museum' characters, stress was naturally laid upon fresh colour variation, the distribution and shape of foot-pads, colour of iris, comparative measurements, and so on.

The general result was to reveal that "almost every variation, however slight, tallied with some recognizable alteration either of habitat or of conditions in the habitat" (p. 628), and that "most species were confined to a single vegetational zone . . . some extended over two such zones, but in only one case was an animal taken from more than a few paces beyond the edge of its zone or zones" (p. 631).

The minute analysis to which specimens were subjected brought out several interesting points bearing upon taxonomic characters. Colour, for example, was found to be unreliable, sometimes because it faded in different degrees according to the method of preserving the pelt—the skins of a maroon-coloured rat, *Malacomys longipes*, turned out grey, dark brown or bright reddish-brown, according to whether they were dried in a closed container, in shade or in bright sunlight. Some cases of local orange or red coloration appeared to be due to staining by a food plant, since the colour could be washed out. The dorsal bright green of four arboreal species is attributed either to the presence of minute algæ or to refraction (the unconvincing reason given for the latter suggestion being that the colour fades rapidly after death); but a minute examination of the hairs should have decided the matter once and for all.

Sometimes the field characters pointed to conclusions regarding classification which could not be deduced from museum skins, as when they indicated two or more divergent groups the evidence for which was lost in the preserved material, or when specimens "rather homogeneous in life" presented characters, in their preserved state, which might have warranted the creation of sub-species.

The author set out deliberately to test by his own thorough methods the validity of the criteria upon which systematics are based, and his conclusion encourages belief in the long-established technique, for when the field determinations were compared with recognized classification "the two sets of identifications coincided exactly as regards genera", and "in the majority of cases, also, species as defined in the field corresponded to species as recognized and recorded in current literature". In the matter of the finer subdivisions, however, difficulties presented themselves, and it was found to be difficult to equate the field subspecific types with the named subspecies.

Many interesting observations were made in the course of the exploration, such as that of the spherical hanging nests inhabited and said to have been built by *Cercopithecus preussi*, or of the giant and dwarf races of shrews here attributed to the abundance or scarcity of food available in different places, or of the cats (*Felis catus*) run wild in farmland and secondary forest which all had pale blue eyes, whereas in the village cats the iris varied between green and yellow.

Men of science, like Government Departments, are often pilloried for their misuse of the English language. Here there is a tendency to 'excessiveness'—"most forest animals tend to be excessively confined in their distribution"; two related species of Cercopithecus are "totally different"; "true constancy is exceptional". But the merit of this field monograph and of the author's drawings, coloured and uncoloured, of many species deserves the highest praise. If a word of advice may be given it is that a scientific paper, instead of indicating subtle colours in vague terms which convey different impressions to different people, would better describe them by reference to accepted colour standards such as those in Ridgway's well-known book on the subject.

---

[1] *Trans. Zool. Soc. Lond.*, 24, Pt. 7, 623-725 (1940).

ASPECTS OF THE TOTALITARIAN STATE

A SYMPOSIUM on the totalitarian State from the points of view of history, political science, economics and sociology has recently appeared (*Proc. Amer. Phil. Soc.*, 82, No. 1; 1940). Discussing totalitarian politics, F. M. Marx points out that totalitarianism and constitutionally safeguarded individual rights are incompatible. The corporative order is essentially an effort to interlock the entire occupational and social structure with the centrally controlled political hierarchy, and it cannot respect the difference between persuasion and brutal force. Totalitarianism is essentially anti-intellectual, but its character is dynamic and it would never have gained hold if it did not satisfy a human need not otherwise met. Its corporative features may well change the structure of the nation State so as to set a new international standard, and freedom of choice will only be retained by dealing effectively with those domestic conditions which cry out for redress.

Prof. Thomas Woody deals with the principles of totalitarian education, which he characterizes as aristocracy, anti-pluralism, anti-rationalism, collectivism and activism, the last-named differing from the liberal interpretation in permitting and encouraging only controlled activity, limited to the attainment of pre-determined goals. These principles constitute the basic educational framework of societies that look for stability and perpetuity on the basis of strict regimentation of the individual's capacities rather than through free development. They rest on the conviction that liberalism failed to show that men, if they had freedom, would use it for the common good.

Prof. H. Kohn, discussing the totalitarian philosophy of war, points out that in totalitarian philosophy war is the normal and welcome concomitant of all life, the supreme manifestation of vitality and virtue, an unalterable and dominating part of the whole system, whereas in the liberal conception wars exist only as a result of the shortcomings of the political and social order and may be overcome by the rational efforts of man. Ultimately, these two concepts of war rest on different concepts of the nature and destiny of man. Prof. C. R. Whittlesey, in reviewing the relation of totalitarianism to international trade and finance, suggests that the most significant feature of the economic policies of totalitarian States is their disregard of cost as the term is customarily understood, and from this fact arise most of the problems confronting countries competing with totalitarian States.

The totalitarian States, however, differ among themselves, as Mr. M. J. Bonn points out, as to the place of economics in the affairs of the world. In Italy and Germany, economics are only means which society needs for the pursuit of its main purpose, 'power', in order to dominate other societies and grow at their expense in accordance with the law of Nature which makes weaker and less numerous societies the prey of their stronger rivals. The pursuit of life, liberty and happiness for individuals as objectives of policy is senseless; they can only be reached as by-products of national welfare.

Communism, however, not only accepted but even stressed the rationalist doctrines of liberalism that growth and welfare of societies are regulated by immutable economic laws, the discovery of which enables man to develop a more or less perfect human society. It differs from its predecessors as to the proper nature of these laws, but they can be used to speed up development when they have been properly recognized. On the assumption that communists are in full possession of these laws, their dictatorial acts are not arbitrary. They merely impose the laws of the universe on those unable to discern them. Fascism and nazism are thus opposed to communism, because of its basis on reason and deduction and because it represents an impersonal scientific approach to objective truth by way of the intelligence and not through the emotions.

Discussing the novelty of totalitarianism in the history of Western civilization, Prof. C. J. H. Hayes considers that this novelty lies in the fact that dictatorial totalitarianism is really totalitarian, monopolizing all powers, subordinating all institutions and groupings, leaving no room for the free play of individual wills and recognizing no utility in free inquiry. Secondly, it commands and rests upon mass-support, and is not the affair of an aristocratic class or military caste. Thirdly, it is maintained, and its overthrow rendered unusually difficult, by novel and marvellously effective agencies of popular education and propaganda. It also possesses an allure through the emotional and essentially religious spirit which its leading apostles have infused into it. It has evolved a new pattern of methods and techniques, and in its exaltation of might and force as an end in itself is another novelty. It is essentially a revolt against the whole historic civilization of the West, but as an antidote to undue pessimism Prof. Hayes points to the improbability of a novelty of the last two decades outlasting what has long endured, and secondly to the resourcefulness of man, which has as often brought him liberty and fraternity as his inertia and submission have brought him dictatorship and slavery.

INDUSTRIAL INJURIES IN WAR-TIME

A REPORT by Prof. H. Levy on "War and Industrial Injuries" which has been issued by the Fabian Society (Tract Series No. 253) emphasizes the importance in the war effort of the fitness of the army of industrial workers behind the soldier, and directs attention to the cost of industrial accidents not only in sums paid for compensation but also in the loss of working time, both direct and indirect. In present circumstances it is emphasized that we must use to the full every ounce of man-power we possess that can be employed on production and that the present arrangements for preventing accidents and still more for the treatment of injuries and of industrial disease result in a very great and unnecessary waste of man-power—a wastage which is likely to be enormously increased under war conditions.

Prof. Levy therefore urges that one of the most important single contributions to the war effort would be the immediate introduction of expedients designed both to minimize the occurrence of accidents and to improve the facilities for treating the injuries resulting from them. The proposals put forward are essentially intended for the consideration of the Royal Commission on Workmen's Compensation, as any final solution involves drastic reform both of the law of workmen's compensation and the system of National Health Insurance. The main purpose, however, of any immediate proposals should be to create throughout the industry of this country institutions charged with the continuous and positive duty of preventing accidents so far as possible, and, where accidents occur, of providing for rapid and effective treatment of the victim. The changes now being made in factory administration, and the establishment under the chairmanship of Mr. Ernest Bevin of a new Factory and Welfare Advisory Board, provide a unique opportunity to use the new powers of the Ministry of Labour to extend and develop this type of organization over the whole of industry.

With regard to organization, the essential is that for a well-established industry of any size those who are vitally concerned in the running of the industry and who understand its problems should be entrusted with the task of preserving its man-power. Where joint standing committees do not exist, associations of employers and employees should be asked to form committees and compulsion brought to bear if this is not done voluntarily within a limited period of time. For small, scattered or ill-organized industries or occupations the Ministry should itself set up a welfare and safety organization partly of official members and partly of representatives of those engaged in the trade or occupation. To function effectively, such committees must be given really wide powers, including the right to visit any plant in the industry with which they are concerned, to inspect its safety provisions, make additional suggestions and under prescribed regulations inflict fines for the non-observance of safety provisions. The committees should be under an obligation to provide medical treatment for injured workers where the injury is serious, the treatment to be arranged so as not to interfere with existing arrangements, which at present are sketchy and inadequate. The committee would also be able to arrange far more efficiently than any centralized board for special attention to the particular problems of its own industry.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SUPERVISOR OF DOMESTIC SCIENCE TRAINING in Jamaica—The Secretary (I.P.R.), Board of Education, Kingsway, W.C.2 (August 26).

PROFESSOR OF GEOGRAPHY at the Higher Teachers' College, Baghdad—The Secretary (I.P.R.), Board of Education, Kingsway, W.C.2 (August 26).

TEACHER (MAN) OF ENGINEERING SUBJECTS in the South Dorset Technical College, Weymouth—The County Education Officer, County Education Office, Colliton House, Dorchester, Dorset (August 26).

PROFESSOR OF HOME SCIENCE in the University of Otago—The High Commissioner for New Zealand, 415 Strand, W.C.2 (August 31).

LECTURER IN BIOCHEMISTRY in University College, Dundee—The Secretary, The University, St. Andrews (August 31).

GRADE II (C) LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Secretary, The University, Birmingham 3 (August 31).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1939. Pp. 90. (Reading: National Institute for Research in Dairying.) [68

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 22, 1939. Pp. iii + 248. (Sheffield: The University.) *7s. 6d.* [68

Witherite (Natural Barium Carbonate) and its Industrial Uses. Issued jointly by the Holmside and South Moor Collieries, Ltd., and the Owners of Settlingstones Mines, Ltd. Pp. 56. (Stanley, Co. Durham: Holmside and South Moor Collieries, Ltd.) [88

Other Countries

Proceedings of the United States National Museum. Vol. 88, No. 3091: A Prehistoric Roulette from Wyandotte County, Kansas. By Waldo R. Wedel and Harry M. Trowbridge. Pp. 581–586. Vol. 89, No. 3092: A Revision of the West Indian Beetles of the Scarabaeid Sub-family *Aphodiinae*. By Edward A. Chapin. Pp. 42. (Washington, D.C.: Government Printing Office.) [297

Newfoundland Government. Research Bulletin No. 8: Lobster Tagging on the West Coast of Newfoundland, 1938. Dr. Dr. W. Templeman. Pp. 16. (St. John's: Department of Natural Resources.) [297

Madras Fisheries Department. Fish Statistics for 1928–29, 1929–30 and 1930–31. Edited by Dr. B. Sundara Raj. (Reports 2, 3 and 4 of 1937, Madras Fisheries Bulletin, Vol. 27.) Pp. iv + 71–264. (Madras: Government Press.) 2.14 rupees. [297

India Meteorological Department. Scientific Notes, Vol. 8, No. 88: A Historical Note on the Standard for the Measurement of Atmospheric Pressure in India. By J. M. Sil. Pp. 47–66. (Delhi: Manager of Publications.) 10 annas; *1s.* [307

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 11: Interatomic Forces and Helium in Rocks. By Norman B. Keevil. Pp. 311–360. 1.50 dollars. Vol. 73, No. 12: Some Physical Constants of a Few Hydrocarbons and their Structural Isomers. By Mieczyslaw Wojciechowski. Pp. 361–370. 35 cents. (Boston, Mass.: American Academy of Arts and Sciences.) [317

Astrographic Catalogue 1900·0. Sydney Section, Dec. −51° to −65°. From Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 22: R.A. 6h to 12h, Dec. −56° to −58°. Plate Centres Dec. −57°. Pp. 98. (Sydney: Government Printer.) [317

De Tuberculine Reactie. Door Injo Beng Liong. Pp. viii + 203. (Batavia: Medical College.) [18

Instituto Nacional de Tecnologia (Ministerio do Trabalho, Industria e Comercio). Estudos sobre o tratamento de agua por coagulação. Por Eros Orosco, E. Frias Rocha e E. Goulart de Andrade. Pp. 28. Gordura de Batí: considerações para o estudo do problema da oblenção em bases industriais. Pelo Jayme Sta. Rosa. Pp. 26. Papoula de São Francisco. Pelo Walmir A. Teixeira de Carvalho. Pp. 48. Metrologia (métodos óticos nas medidas de comprimento de alta precisão). Pelo J. Costa Ribiero. Pp. 28 + 4 plates. A Mandioca: sua industrialização, seu valor econômico. Pelos Ruben Descartes de G. Paula e José Luiz Rangel. Pp. 60 + 4 plates. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [18

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 96: Further Investigations on Copper Deficiency in Plants in South Africa. By D. S. Riceman, C. M. Donald and S. T. Evans. Pp. 44 + 10 plates. (Melbourne: Government Printer.) [68

Newfoundland Government. Research Bulletin No. 9: A Preliminary Study of Newfoundland Trout. By Nancy Frost. Pp. 30. (St. John's: Department of Natural Resources.) [68

Catalogues

Rapid Testing applied to Foods, Chemicals, etc., in Industrial and Scientific Research, by Fluorescence with the Hanovia Analytic Lamp. Pp. 20. (Slough: Hanovia, Ltd.)

Chemicals, Reagents. (Catalogue No. 65CR.) Pp. 64. Wade Laboratory Porcelain. Pp. 4. (London: Griffin and Tatlock, Ltd.)

A Catalogue of Important Books, including Americana, English Literature, Music, Ornithology, and Important New Books. (No. 578.) Pp. 40. (London: Bernard Quaritch, Ltd.).

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 24, 1940 No. 3695

FOOD POLICY AND EUROPEAN RECONSTRUCTION

IN the rude awakening which has come to public opinion in Great Britain and indeed elsewhere since the spring of this year, it is significant that the intensification of our national effort in the prosecution of the War has not eclipsed consideration of the problems which will confront us after the War in the task of reconstruction, whether in Great Britain or in the rest of Europe. In part it may be true that we are compelled to offer an alternative to the serf plan of European reorganization which Hitler offers. We cannot allow his plan to unite Europe to be propagated abroad without at least the broad outlines of a juster scheme which free men and nations could prepare.

The constructive and creative thought lying behind propaganda of this type is indeed a part of the war effort, to which it could well be argued that the Ministry of Information or the British Council might devote more attention and energy. The livelier and keener attention which is now being given to this question and the major problems it presents, as compared with the more academic debates of last autumn are not, however, primarily due to questions of propaganda or prestige. Fundamentally, they are due to the growing realization that the social and economic orders are changing and will demand a new type of society after the War if stability and security are to be achieved.

The mingling of the streams of social and international policy has thus forced us to consider reconstruction and the rebuilding of world order as part of the higher policy directing our war effort. It is indeed fortunate, as we have many times insisted, that much of the planning demanded primarily for war purposes frequently lends itself admirably to planning for reconstruction.

Prof. E. H. Carr remarks in "The Twenty Years Crisis" that ultimately the best hope of progress towards international conciliation seems to lie along the path of economic reconstruction. The same view that economic reconstruction to make it impossible for Europe again to be afflicted with economic distress like that of 1929–33 is a peace aim of the first importance has been repeatedly reiterated during the last twelve months. It is a main theme of Mr. J. E. Meade's admirable study "The Economic Basis of a Durable Peace" (London : George Allen and Unwin, Ltd., 1940. 6*s*. net.), in which he outlines a basis upon which a just and efficient system of international economic relations would be built.

A feature of the scheme is its endeavour to raise the general standard of living so far as possible and reduce inequality between nations and between classes. This would be done partly by the device recommended by the Bruce Committee and the editors of *Planning* of raising revenue to be spent in developing the more backward regions ; in enabling the Balkans, for example, to take full advantage of the technical knowledge, the experience and the superior credit of more prosperous States. The importance of this task to the rest of the world is well brought out by Mr. F. L. McDougall, the Australian representative on the Imperial Economic Committee, in a valuable pamphlet "Food and Welfare" (Geneva Studies, vol. 9, No. 5, November 1938. Geneva Research Centre). In that area of Eastern Europe the economy depends almost entirely on primary products and material civilization has been retarded by their unhappy history.

A European development fund administered in that area with no after-thoughts, with no purpose except that of the improvement, economic and political, of those populations, would help to solve poverty throughout Europe in raising the level of life among the poorest peoples. These peasant populations, it should be remembered, provide almost virgin markets for industrial products. While the local consumption of protective foods must be increased in these peasant districts if a satisfactory level of health is to be ensured, these areas could still meet a large part of the demand for increased supplies of dairy products, eggs, fruit and vegetables for industrial Europe which national nutrition policies would postulate.

If, therefore, the war exigencies lead us to envisage and pursue an adequate policy of nutrition as part of our food policy, the development of that policy of nutrition in the very forefront of our economic policy on the lines recommended by the Bruce Committee should follow as a matter of course after the War. The placing by the industrial nations of improved levels of nutrition and rising standards of living in the forefront of their economic policies would create large new demands for food and raw materials. Besides stimulating their own agricultural production, especially of liquid milk, vegetables and the other more perishable forms of the protective foods, this would necessitate large increased imports of energy foods, animal feeding stuffs and the less perishable protective elements. Thus imports would be paid for by increased exports to the predominantly agricultural countries, with the result of markedly increasing world trade.

The profound disturbance to food production and distribution in Europe caused by the German occupation of Denmark, Holland, France and other countries in no way invalidates this conclusion that all nations feel the benefit of advances in nutritional policy, and it is against this background and in this prospective that we must assess proposals at present being put forward regarding the relaxation of the blockade or the storage of foodstuffs against famine. The appeals to the well-known philanthropy of the American people to break the blockade clearly derive their inspiration from enemy sources. The legal and moral issues at stake have been admirably summarized by Prof. A. L. Goodhart, an American who is professor of jurisprudence at Oxford in a letter in *The Times* of August 8. The distress which is already being felt in the countries occupied by Germany is largely the result of the deliberate policy of the German Government which has exploited these territories by denuding them of everything that could be added to German reserves or serve the purposes of German industry. The recent assertions from Germany that her food situation is absolutely secure further invalidates the claim that Germany should be relieved of responsibility for the feeding of those she has conquered and plundered.

The situation in Europe to-day presents no parallel or analogy with that of occupied Belgium in the War of 1914–18 when supplies were sent into occupied Belgium for distribution to the civilian population under neutral control. To-day no neutral control could be devised which would afford the slightest guarantee against abuse of any philanthropic enterprise. Any supplies reaching Nazi-occupied Europe are a direct or indirect asset to Germany and would be used without scruple for her own purposes.

If, therefore, any relaxation of the blockade of any country under German domination is unthinkable, reaffirmation of the integrity of the blockade might well be accompanied by an assurance of immediate relief as soon as that domination is removed. It is the constant purpose of Great Britain and should be a first concern of the Ministry of Information to strengthen the spirit of independence in the occupied countries, to encourage their will to resist and engender a consciousness of comradeship with those outside who are carrying on the struggle.

These are among the reasons which give fresh pertinence to the planning of a definite policy for the relief of Europe as soon as the downfall of Nazism is achieved. Such a policy would involve the co-operation of the United States and of other overseas countries, including the British Empire, some of whom have already displayed a special interest in nutrition problems.

If the situation is to be met, planning on scientific lines is essential. Much indeed of the basic knowledge is already available through the inquiries set on foot by the Bruce Committee. In the building up of large stores of surplus foodstuffs ready to be shipped into Europe as soon as Nazi domination comes to an end, as suggested by Colonel Meinertzhagen, we must take account not only of surpluses accumulating in the Americas but in Africa also. As Dr. Julian Huxley points out in a recent issue of *The Times*, if may be necessary to buy up surplus products, not only of human foodstuffs but also of animal foodstuffs and other raw materials, if the entire economy of certain large tropical regions is not to collapse. Some surpluses, such as vegetable oils, require processing, involving in turn the purchase of suitable machinery from countries whose industry is not overtaxed by armaments production and this, like the provision of storage facilities, should form part of a comprehensive plan.

Dr. Huxley's proposals indeed merit close and immediate attention. To draw up such a programme now is not only an elementary measure of foresight. It would also demonstrate that democracy can plan for the needs of peace as decisively as a dictatorship, and without sacrificing the essentials of freedom. It is the most effective answer to the pretence that British policy is bringing starvation to Europe. It is not enough to point out that it is Nazi Germany which is starving Europe. Active preparation to feed Europe as soon as the present tyranny is overthrown is the first step to the establishment of a new European order enshrining the ideals for which Great Britain and those with her contend.

The supreme need behind such a plan is for enough public spirit and enlightenment to break through prejudices and inhibitions and act with courage and imagination. Alike in the prosecution of the struggle to which we are committed, and the building of a juster and more tolerable social order when victory has been achieved, there must be no weakness in the face of vested interests or conservative prejudice.

HENRY BESSEMER AND SIDNEY GILCHRIST THOMAS

Sidney Gilchrist Thomas
An Invention and its Consequences. By Lilian Gilchrist Thompson. Pp. 328+8 plates. (London: Faber and Faber, Ltd., 1940.) 12*s*. 6*d*. net.

IN 1856, an Englishman who had recently invented a rotating projectile was witnessing gun-trials with it on a French artillery practice ground near Paris. At that time, both gun and projectile were made of cast iron. These trials were a failure because of the frequency with which the gun burst, and the French commandant, who was in charge, said to him: "This invention of yours will require a better gun than one made of cast iron." So Henry Bessemer, for it was he, returned to England to make a gun tube that would not burst on firing.

He set to work at a foundry in St. Pancras, and after a few experiments conceived the idea of removing the impurities from molten cast iron without external heat, by blowing air through it and oxidizing them. He was a man of considerable financial resources, and in less than a month had carried out his experiments successfully. He constructed a 'converter', which was simply a pear-shaped iron shell with a fireclay refractory lining fitted with tuyeres through which the air was blown. The only difficulty he had in conducting the first experiment was with his assistant, who thought he was quite mad. However, he succeeded in making him pour the melted iron from the cupola into the converter and started to blow air through it. Neither of them knew what would happen and at first nothing did happen; the reaction started quietly but then became very violent, and nearly set the place on fire. When it had finished, the converter was rotated downwards and the liquid metal poured out into a mould. In this way, he obtained an ingot of what he regarded as malleable iron. Malleable it certainly was, as numerous experiments showed. The product is what is to-day called 'mild' or 'soft' steel. He had within half an hour raised the temperature of a mass of fluid pig iron several hundred degrees, removing the greater part of the impurities without the use of any fuel, and produced a steel which was not brittle. This experiment inaugurated the era of cheap and plentiful steel.

But, to use a modern expression, Bessemer had 'got away with it' rather too easily. Quite by chance, he had used one of the few suitable brands of low-phosphorus pig iron made in Great Britain, and that is why his first experiment was successful. At that time, there was no such thing as the chemical control of the composition of cast iron. Various iron-makers set to work to repeat this process, using their own brands of cast iron, not knowing that what was right for the refinery or puddling-furnace was wrong for converters lined with siliceous materials. Almost without exception the irons produced were worthless since they were quite brittle. This brought about a complete reaction against the process which was denounced as the dream of a wild enthusiast, such as no sensible man could for a moment have entertained.

In those days there was no Iron and Steel Institute, and Bessemer had to try to solve his difficulties himself. He established the fact that it was the phosphorus in the cast iron, which was not removed in the 'blow', which made the resulting steel brittle, and he then tried to remove it by various methods, but without success. By using Swedish non-phosphoric pig iron, however, he was always able to convert this into malleable steel. By now, however, the process was discredited and nobody would take it up, so that he was forced to become a steel-maker himself. He went into partnership with four other men and established a works in Sheffield. This partnership lasted fourteen years. The process was so much cheaper than the established methods of steel-making that their profits were very large. During this period they made eighty-one times their capital. Bessemer thus solved the problem of making steel without fuel from low-phosphorus pig iron. But his process was of limited applicability since the majority of ores distributed over the earth's surface contain too much phosphorus to be amenable to it.

Some fifteen years later, an evening-student at the Birkbeck Institute, listening to a lecture on cast iron, heard the sentence, "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune". The student was at that time a junior clerk in the Thames Police Court at a salary of £90 a year, and his name was Sidney Gilchrist Thomas. That remark lit the flame of desire in his mind to solve the problem. He began experiments in his humble quarters, and enlisted the help of his cousin, Percy Carlyle Gilchrist, who was the chemist at an iron works at Cwmavon in South Wales. Both of them had to work with very slender resources in their spare time. Naturally, progress was slow and the results were frequently disappointing; but they persevered and in the end took out two patents. But by this time they had exhausted almost all their financial resources. However, Mr. Martin, the general manager of the Blaenavon Steel Company in South Wales, came to their assistance. Further experiments were made and, finally, a third patent was taken out in 1878. In the meantime, the Iron and Steel Institute had been founded (1869). Accordingly, Thomas and Gilchrist prepared a paper for presentation at its autumn meeting in Paris in that year. The paper was entitled "On the Elimination of Phosphorus in the Bessemer Converter". So little was its importance realized that it was not even read, but was adjourned until the spring meeting of 1879. In the interval, the inventors got into touch with Mr. Windsor Richards, of Bolckow, Vaughan and Co. The personality of Thomas, in particular, greatly impressed him. Accordingly, arrangements were made for a phosphoric charge to be blown at the works in question, and this was successfully done in April 1879. Thomas and Gilchrist had established that three essential conditions must be satisfied if the phosphorus was to be eliminated from the cast iron.

(1) It was necessary to line the converter with basic material, not merely of the correct composition but also of the requisite temperature stability, so that its adhesion to the converter walls during the blow was maintained. Such a lining could be manufactured from burnt dolomite.

(2) It was essential to form a rich basic slag at an early stage of the process.

(3) While carbon, silicon and manganese were removed at an early stage of the 'blow', the phosphorus was not diminished until later. This necessitated the so-called 'after blow' during which about 80 per cent of the phosphorus is eliminated.

This experiment was completely successful and accordingly, when Thomas and Gilchrist read their paper at the May meeting of the Institute in 1879, they were in a strong position. At this meeting, Sir Henry Bessemer was present and congratulated them on having solved the problem which had proved too much for him. It was admitted by the great majority of critics that they had established their case.

Thomas possessed a very acute mind, and his experience on legal matters at the Thames Police Court stood him in good case when it came to the filing of the patents for what is now known as the 'Basic Bessemer Process'. From being a poor man, he quickly became a well-to-do one. He and Gilchrist thus completed the original discovery of Bessemer by rendering it available for iron ores which contain sufficient phosphorus. In addition, in their process the slag produced is a valuable agricultural fertilizer, and may be regarded as an equally important product.

Although the above facts have been known for the last sixty years, the personal side of Thomas's life and work has only recently been disclosed. He, himself, died in 1885 when he was only thirty-five. His sister, Lilian Gilchrist Thompson, has published his life, under the title of "The Story of an Invention and its Consequences". She is in her eighty-first year. He left the money which he had made to her in a trust for charitable and social purposes. In writing this book, she has frequently let Thomas speak for himself, whether in the form of letters to his mother and herself, to whom he was devoted, or in a series of articles under the heading, "Technical Travel Talk", which he contributed to the columns of *Iron*. There are many who will be grateful to Mrs. Thompson for the story thus told. She has performed her task admirably. Thomas was a man who lived strenuously, and literally wore himself out. His is one of the great names in metallurgy, and he is one of the great benefactors of the human race.

H. C. H. CARPENTER.

CONTRIBUTIONS TO THE HISTORY OF SCIENCE

Osiris, Vol. 7
Edited by Dr. George Sarton. Pp. 616. (Bruges: St. Catherine's Press, 1939.) n.p.

TO those whose interest in science is wide enough to embrace the history of its development in all stages a volume of "Osiris" offers much attractive reading. The field covered is so extensive that few are likely to read all the articles with equal avidity. The contributors equally have shown complete diversity in their choice of subject and in the scale and manner of treatment. Thus the contents present a variety from which readers can make a choice according to their taste.

Each volume of "Osiris" is dedicated to some distinguished scholar. In this, the seventh of the series, tribute is paid to Prof. Gino Loria. His portrait, a biographical sketch by Prof. R. C. Archibald and a bibliography of his writings make a fitting opening of the volume.

A paper in German by Prof. J. Ruska follows, in which he attacks the problems set by the works of the Arabian alchemist Razi, the author of "The Secret of Secrets". These have had a curious fate, for while at least one MS. has passed unrecognized under another part of Razi's very elaborate full name, others which purport to be Latin versions have been mangled in the course of transmission and some have been attributed to Razi without any justification. To distinguish the true text is thus an arduous task, but this work of scholarship on which Prof. Ruska has embarked is essential for the history of alchemy.

The sexagesimal system retains its interest owing to the form of division still adopted for the hour and the degree. The origin of this system is attributed by M. F. Thureau-Dangin to the Sumerians; but his very interesting paper, which is translated into English, deals also with the wider subject of Babylonian mathematics. As this includes the solution of a quadratic equation by rules which represent the usual formula its historical importance is great. Whether this achievement is properly regarded as a beginning of algebra seems doubtful. It is a long way from Diophantus who used symbols, whereas the Babylonians certainly did not. Hence they deserve credit for remarkable skill in arithmetic, which is doubtless the parent of algebra, but the critical step from one to the other is surely to be found at some later date when algebraic symbols are explicitly introduced for the first time.

The development of geometry in the last century with the fundamental change of outlook involved is discussed by Prof. E. Nagel in a technical but very readable paper. He has traced the progressive advance towards more complete abstraction by which geometry has become more and more independent of physical content. Had it ceased to be "useful" in the process there would have been no need to agree with Santayana that it had become "a wasteful and foolish exercise for the mind" except in the same sense as the fugues of Bach. But of course geometry has not become less relevant to an understanding of the physical world through breathing a purer and wider atmosphere, and Prof. Nagel has not failed to consider the modified relation between the two spheres of geometry and observation.

The editor's charming study of Borodin goes far to justify a medium in which men of science can be treated as human beings. In his union of science and art Borodin was unique. As a professor of chemistry he gained his livelihood, played his part in the teaching of his generation and made a quite respectable contribution to the progress of chemical research. As a musician he was a composer of distinct originality and as such he will be longest remembered: *ars longa, scientia brevis.* A reference to William Herschel may be corrected on one point. It is true that Herschel did not run his art and his science in double harness all through his life. But it is not true that he was not a composer. Those who were privileged to hear a selection from his work played under the direction of Dr. G. Dyson at the Royal Astronomical Society conversazione a year or two ago learnt that Herschel's compositions are charming examples in the lighter eighteenth century idiom. In spite of their merit they remain unpublished in the possession of the family.

The paper by S. Gandz on the "Dawn of Literature" fills nearly half the volume and so is out of scale with the rest. That the author's industry in collecting material has been great is attested by some 750 references. But the whole has not been reduced to the form of a connected thesis, and it may be that the subject of oral tradition in the ages before writing was possible and afterwards is too wide for satisfactory treatment. It has many interesting aspects, alike in the religious and the secular, the literary and the scientific spheres. Here these aspects are neither exhausted nor brought into one clear focus.

Nothing need be said about the next paper by M. J. Pelseneer giving unpublished letters of Newton, because this has already been the subject of a note in NATURE. It is followed by one in which Dr. E. C. Watson describes the prominent members of the Paris Academy of Sciences in its early days. This article is based on engravings by Sébastien Le Clerc, a number of which are reproduced. In 1670, Le Clerc was engaged by Colbert as Court engraver and in this capacity he contributed illustrations to several notable works produced by the Academy with the direct encouragement of the king. To this circumstance is due a pictorial representation of the membership and apparatus of the Academy in several settings. This pleasant account makes it a matter for regret that no contemporary artist gave similar attention to the Royal Society.

The volume closes with a short article by Sister M. E. Keenan on "St. Augustine and Biological Science". Perhaps natural history would be more appropriate, and indeed the subject is rather literary than scientific. The source of Augustine's allusions is clearly Virgil and Pliny rather than Nature, and though he may have treated current lore with some reserve, his powers of observation do not seem to have been more than moderate.

H. C. Plummer.

SCIENCE IN BREWING

Brewing

Science and Practice. By H. Lloyd Hind. Vol. 2: Brewing Processes. Pp. xiv + 507–1020 + 62 plates. (London: Chapman and Hall, Ltd., 1940.) 56*s*. net.

It may be said, at some risk of repetition, that brewing is an art, developed throughout the centuries without aid from science. Science now steps in to explain what happens in the brewery, why certain procedures give good and others bad results. Research, both fundamental and technical, is increasing every year the value of science, now harnessed to the art of the brewer.

An example of this function of science in the brewery may be cited. The importance of aeration in securing a satisfactory brewery fermentation has been realized since Pasteur's time. In more recent times the purely mechanical function of aeration, that of 'rousing' or mixing the yeast back into the fermenting wort until it has finished the fermentation, has been stressed. Also within recent years the relationships between alcoholic fermentation, respiration and yeast growth have become much clearer. It now emerges that, fundamentally, aeration in the brewery fermentation vessel is merely necessary to secure healthy growth of the yeast from the small amount that the brewer seeds to the wort to the much larger amount that he normally removes from it. There is no scientific reason why a much higher yeast seed-rate should not be used in practice. This would result in a swifter fermentation and little time for multiplication. Aeration would be quite unnecessary in such a case. The fact is that beer is not, and never was, made in this way, and probably it would have a yeasty flavour and other different characters if it were so made. Moreover, the problem of a supply of healthy seed yeast would arise. But the apparent contradiction between theory (as propounded by Pasteur) and practice in breweries is explained. Science explains the brewers' empiricisms.

Such is one function of the excellent work under notice. To the technician in the brewing industry, it is of course, much more than a mere explanation of long-established practice. It is with its companion volumes a complete handbook of the brewer's art and craft.

The materials used in brewing had been exhaustively treated in vol. 1, which appeared about two years ago. The present volume deals with plant and processes, except that the whole of the processes involved in the bottling of beer are postponed for treatment in a third volume to appear later.

The chapters dealing with mashing are very good. Here, as elsewhere, the opportunity has been taken to incorporate into this volume recent scientific advances which have been published since the previous volume was written. There is also shown throughout a satisfactory blend of scientific discussion and practical empiricism. The processes of boiling with hops, cooling (involving flocculation of protein-tannin compounds), fermentation, conditioning of draught beer, and sections on relevant micro-organisms follow. An admirable chapter on bacteriology as it affects the brewer is contributed by Dr. J. L. Shimwell.

A large number of excellently reproduced photographs of brewery plant adorn the volume, whilst the photomicrographs of yeast in ultra-violet light are the best the reviewer has ever seen. A summary and list of references appear at the end of each chapter, whilst author and subject indexes terminate the volume. The author's long experience as brewer and chemist, supplemented by extensive reading and painstaking labour, have resulted in a book which should be of inestimable value to technicians engaged in the trade.

STUDIES IN FOSSIL BOTANY

An Introduction to the Study of Fossil Plants
By Prof. John Walton. Pp. x + 188. (London: Adam and Charles Black, Ltd., 1940.) 15*s*. net.

THIS book, intended for those who have had at least a year's university or college course in botany, will be welcomed not only by university students but also by those select readers who desire a brief, well-balanced account of the fascinating succession of floras that have clothed the earth. The value of the descriptive matter, which is clear and concise, is enhanced by the illustrations, which are generous in number and well chosen. The probable relationships between the living and the fossil representatives of the various groups of plants are adequately indicated, while fruitless speculation on the more problematical affinities has been avoided. D. H. Scott's "Studies in Fossil Botany" being now out of print, the book under review replaces it in the publisher's lists.

In his preface, the author expresses the hope that his readers will make a point of examining the actual specimens of fossil plants which are preserved in university and museum collections, and that they will institute active searches for fossils in such likely places as quarries and the spoil-heaps of collieries: such a course will indeed amply repay, in increasing understanding and zest, the trouble involved. Even the novice may hope to have the good fortune to find specimens which are worthy to be added to the priceless collections in our museums, and may also find hitherto unknown localities for fossils which may possibly yield a rich harvest of new forms.

The first chapter of the book classifies plant remains in general into compressions, incrustations, casts and petrifactions, and gives an excellent account of the many methods employed in investigating the specimens in the laboratory. Great advances have been made in a number of these methods in recent years, and Prof. Walton has been in the forefront of those who have made them; one of the most remarkable results of micro-palæobotanical research was his discovery of the oldest known (Carboniferous) liverworts (p. 22).

The body of the work deals with the chief groups of plants in the order of increasing complexity, each group being illustrated by a number of types. In the account of the Thallophyta it is shown that the recognition of fossil bacteria depends less on their external form than on the traces of their physiological activity. This would have been an appropriate place for a brief reference to the role of anaerobic bacteria in coal-formation and for mention of the recent work of Lipman, Farrell and Turner on the bacteria occurring in coal. On the other hand, the description of Pachytheca might well have been omitted, since its vegetable nature is open to doubt. The description of the early vascular plants is a particularly good review of exceptionally difficult material.

A reference to the spores which occur abundantly in most coal-seams is made in the account of the Lycopodiales, plants which disseminated spores in countless numbers. The preparation of graphs summarizing the vertical distribution of arbitrarily chosen spore-types in coal-seams has recently been pressed into service in the difficult task of endeavouring to correlate the seams. This method is, however, still in its early stages. While it may be doubted whether sufficient evidence has yet been adduced to warrant the statement (p. 57) that "a similar graph is usually obtained if the same seam is analysed in a different part of the coal-field", it is certainly not necessarily true that "a different seam will show quite a distinct form of graph".

The final chapter of the book, on the succession of the floras and climates, is full of interesting matter. The climate of Europe and North America during Upper Carboniferous times is described as "probably warm" (p. 135) and as "between temperate and tropical" (p. 174), but the plant evidence on this point may be regarded as less conclusive than even these statements imply. Furthermore, studies on certain other forms of contemporary life and on certain sediments have led to conclusions which are actually contradictory. Despite the uncertainty, as Prof. Walton points out, we have considerable evidence, important to the botanist, as to the ecological conditions under which the plants lived.

The text is completed by a representative bibliography and a useful index; the outline classifications given at the beginning of most of the chapters, and the several tables included in the text, are valuable guides to the complex botanical and geological divisions. This book is a stimulating account of the subject and admirably fulfils its purpose. Both the author and the publishers are to be congratulated on the production.

R. CROOKALL.

A Flora of Cambridgeshire

With an Appendix on the Origin and Drainage of the Fens. By Dr. A. H. Evans. Pp. xi+228. (London and Edinburgh: Gurney and Jackson, 1939.) 7*s.* 6*d.* net.

As there has been no Flora of Cambridgeshire published since Babington's in 1860, a modern flora of the county was much to be desired. Unfortunately this book does not fill the gap adequately, and compares very unfavourably with such a book as the recently published "Flora of Devon". For most species no dates or authorities are given for the records. For example, twenty localities are given for *Astragalus glycyphyllos*, of which fifteen occur in Babington's Flora; the other five are new, but no indication is given of their date or of where the plant still occurs. Relhan's name is cited for the Shelford locality but not for Madingley or Impington, from which places no more recent record than his was known to Babington.

Unfortunately, also, the book contains many errors. *Prunus insititia* is not a green-twigged woodland plant nor is *Juncus bulbosus* "not uncommon" but very local. The Cambridge University Herbarium has not been properly consulted, so that many important records are entirely omitted. As examples may be cited *Medicago denticulata* (a plant not included in the Flora) from near March (Little), *Cardamine hirsuta* from Chatteris and *Apium inundatum* from Ditton and Hardwick.

While it is useful to have a record of the author's great personal experience of the plants of the county and while the book contains much useful information, the need for a good modern Flora of Cambridgeshire remains unfilled. E. F. Warburg.

Essai de météoropathologie

Physique, clinique, thérapeutique. Par W. Kopaczewski. Pp. 296. (Paris: J.-B. Baillière et fils, 1939.)

That certain disorders are caused or influenced by environment, atmospheric conditions, weather, has been surmised from ancient times—for example, ague and swamps, rheumatism and dampness—and in his introduction to this book the author reviews the contradictory evidence thereof. It is also often difficult to disentangle purely environmental from other factors; thus, we now know that swamps generate ague only because they breed the mosquitoes which convey the disease. The author first surveys the physical factors of the air and sun concerned with climate, the physiological details connected with these, and meteorological data. Next, regulation of body function necessary in a changing environment is dealt with, followed by a discussion of the results upon the body of extreme variations in atmospheric pressure and temperature, exposure to actinic rays, and electric shock. Finally, the treatment of the 'shock' thus caused is considered.

Unfortunately, no information or discussion is included respecting the more subtle influence of minor meteorological disturbances upon body function, such as ordinary variations in barometric pressure, in humidity and in temperature, alterations in direction and force of the wind, and the like, and it is about these that we are still so ignorant. A valuable section of the book deals with the climate of France, with full meteorological data, and illustrated with fourteen excellent charts.

Aspects of the Calculus of Variations

Notes by J. W. Green, after Lectures by Hans Lewy. Pp. vi+96. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 4*s.* 6*d.* net.

This little book contains valuable notes taken of lectures delivered at the University of California in the spring of 1938. The aim of the lecturer was to acquaint the student with a skeleton of the methods, rather than the theorems, of the calculus of variations. Familiarity with the chief methods used in the study of functions of a real variable is assumed.

The notes are divided into six chapters which deal with the derivation of the necessary equations for a continuous function to assume maximum or minimum values; quadratic problems in one variable; the Weierstrassian field theory; a general theorem on existence of absolute minima; an introduction to harmonic functions and the Dirichlet problem; Plateau's problem and conformal mapping. As the literature on these aspects is either of recent date or is not easily accessible, these interesting notes should be of much use to all students of this subject.

New First Course in the Theory of Equations

By Dr. Leonard Eugene Dickson. Pp. ix+185. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 10*s.* 6*d.* net.

This book is founded upon the author's earlier work but is written "in a more expansive style with many illustrations either following or preceding the introduction of new ideas or topics, and with minute attention to details". Proofs have been simplified, so far as possible; more exercises have been added, whilst others have been discarded and additions have been made to the text in order to bring it up to date.

Introductory chapters deal with complex numbers and the elementary theory of roots, after which cubics, quartics and the use of graphs are discussed. Then follow the various methods in use for solving numerical equations, brief discussions of determinants, matrices, symmetric functions, elimination, resultants and discriminants. Finally, the general theory of polygonal constructions is considered analytically. This is a logical sequel to an earlier chapter on some particular impossible constructions by ruler and compasses. The book closes with an appendix on the fundamental theorems of symmetric functions and of algebra.

As the subject naturally touches the borders of so many other fields of study, it is always difficult to render a treatment of the theory of equations in any way complete. Nevertheless, the author has produced an interesting first course which should be quite useful to students as an introduction to the subject.

THE SUPPLY OF ANIMAL FEEDING-STUFFS

By Dr. Norman C. Wright,

Director, The Hannah Dairy Research Institute, Kirkhill, Ayr

THE statement made recently by the Minister of Agriculture that British farmers should aim at self-sufficiency in regard to their supplies of animal feeding-stuffs raises the interesting question as to whether such self-sufficiency could, in fact, actually be achieved on a nation-wide scale.

Some two years ago I made an estimate of the total supplies of home-produced and imported feeding-stuffs available for the live-stock population of the United Kingdom[1]. A recent re-examination of the feeding-stuffs position[2] has confirmed this earlier estimate. Briefly, it may be stated that the total pre-War supplies amounted to about 42 million tons of feeding-stuffs (expressed as dry food), which provided some 22 million tons of starch equivalent and 3½ million tons of protein equivalent. Roughly 60 per cent of these nutrients were derived from British grassland, either in the form of grazing or hay, about 14 per cent were supplied by the home production of cereals and root crops, while various by-products (such as brewer's and distiller's grains and fish and meat meals) provided a further 1 per cent. The remaining 25 per cent had to be imported from overseas, either in the form of cereals (chiefly maize and wheat offals) or oilseed products. The volume of imported feeding-stuffs which the British farmer is urged to replace by home-grown produce may, therefore, be roughly estimated at 10 million tons, containing about 5 million tons of starch equivalent and 1 million tons of protein equivalent.

In considering how far this feeding-stuffs gap can be closed, three salient facts must be taken into account. First, of the total home-produced nutrients, about two-thirds are obtained directly from summer grazing. Any curtailment in the volume of imported feeding-stuffs will therefore result in a relatively larger gap in the winter supplies, and any increase in home production will, in consequence, need to take the form of feeding-stuffs which are capable of conservation for winter use.

Secondly, there are two classes of stock, pigs and poultry, which cannot utilize large quantities of coarse feeding-stuffs, and which have therefore to subsist chiefly on cereals and protein-rich concentrates. Such stock are liable to be particularly badly hit by any reduction in the feeding-stuffs imports.

Thirdly, it must also be realized that a reduction in overseas imports may not be the sole cause of a shortage of feeding-stuffs. Disorganization of the home fishing industry has, for example, already caused a reduction of about 60,000 tons in the supplies of fish meal, while the threatened raising of the extraction rate of wheat to 85 per cent would reduce the quantity of offals available for live-stock by as much as 900,000 tons. Again, the ploughing-up campaign, while adding materially to the total food production of the country, will itself cause a reduction of between 50,000 and 100,000 tons in the supplies of protein and starch equivalent which will be available for animal feeding.

The above facts will inevitably increase the difficulty of closing the feeding-stuffs gap. In attempting to close this gap, three lines of action are possible: first, the exploitation of new sources of supply; second, the adoption of modified feeding methods; and third, a compulsory reduction in the live-stock population.

As regards new sources of supply, a wide variety of methods has been suggested for increasing the home production of nutrients suitable for stock feeding. A recent review of these methods[3] indicates, however, that few of them are capable of making a really significant contribution towards closing the feeding-stuffs gap. For example, the more efficient utilization of kitchen waste, which was the subject of a special article in Nature[4], could at best only replace about half of one per cent of the pre-War imports, while improvements in the methods of conservation of slaughter-house offals might achieve an increase of about the same order. The pre-digestion of straw with alkali, the potentialities of which were explored by Germany in the War of 1914–18, is at present the subject of intensive research in Great Britain. The object of the treatment is so to improve the nutritive value of straw now used for litter that it can usefully be fed to live-stock. The treatment of, say, 10 per cent of such straw (an optimistic estimate in introducing a very novel practice to a very conservative industry) would, however, only replace 2 per cent of the energy content of the pre-War imported feeding-stuffs, while it would have no effect on the supply of protein.

So far as the protein portion of feeding-stuffs are concerned, the use of synthetic non-protein nitrogen compounds such as urea has been advocated as a substitute for part of the protein in the rations of ruminants. In order to make good the low protein content of cereals *in the rations of dairy cattle alone* it would, however, be necessary to envisage an output of urea of the order of 50 tons per day, a quantity which is certainly well beyond the present capacity of the country's production plant. Again, it has been suggested that, as an alternative means of making good the protein deficiency of home-produced feeding-stuffs, the cultivation of protein-rich crops such as beans should be increased. This could, of course, only be done at the expense of an existing crop, say oats. If this latter fact is taken into account, even the doubling of the present bean acreage would only increase the supply of protein equivalent by about 10,000 tons (1 per cent of the pre-War imports), while it would simultaneously *decrease* the supplies of starch equivalent by about 16,000 tons. The same general finding applies to all other crops which have been advocated as potential sources of increased supply.

It is clear from the above facts that most of the suggested new sources of supply, while no doubt of use on certain individual farms, cannot be expected to contribute significantly towards the closing of the feeding-stuffs gap. There remains one further source of supply which has not been discussed, namely, grass silage. The Ministry of Agriculture is clearly pinning much faith on the development of this form of conserved fodder as a means of replacing imported feeding-stuffs. The immediate aim is stated to be the production of one million tons of silage from the present season's aftermath. This would, it is true, only replace about 2–3 per cent of the pre-War feeding-stuffs imports. The above figure is, however, clearly an interim one: a far greater effort would obviously be called for over a complete grazing season. In this connexion it may be noted that a ten-fold increase in the present objective, that is, an annual production of ten million tons of silage, would replace about a quarter of the pre-War imports—a really substantial contribution. Although such a large output might appear somewhat impracticable, it would require the provision of only three small (30–40 ton) silos on every agricultural holding of more than 150 acres—an achievement which should not prove impossible in time of really serious emergency.

It would not perhaps be out of place to mention at this point one other *indirect* method of increasing the proportion of home-produced nutrients, namely, a return to summer milk production and an intensification of summer meat production. The term 'indirect' is used because the method involves the storage of the finished products themselves (dried or condensed milk, cheese, meat, etc.), instead of the storage of the grass herbage as hay or silage. The method would entail a drastic changeover in management (for example, in rearranging calving dates), but as a long-term measure has obvious advantages.

Taking into account all the above sources of supply, it does not appear that they could replace more than about one third of the pre-War imports of feeding-stuffs. For further savings it is necessary to turn to the second line of action, namely, the adoption on the farm of more economical systems of feeding.

There is no doubt that substantial savings could be effected by this means if rationing on a basis of modern feeding standards were to be adopted on a nation-wide scale. The general tendency of recent animal-feeding experiments, whether with cattle, sheep, pigs or poultry, has been to show that the older feeding standards can be markedly reduced without adversely affecting the health or productivity of the stock. Reductions of the order of 20 per cent may, indeed, be made in the protein and/or energy contents of most rations. Again, the methods of feeding beef cattle and sheep could well be modified under war conditions, when the provision of an *adequate quantity* of meat is more important than the attainment of *superfine quality*. Again, war-time methods of stock-feeding (for example the Lehmann system of pig-feeding) permit the use of more coarse feeding-stuffs (and therefore of more home-produced roughages) than is normally considered practicable.

It is not easy to estimate the total savings in imported feeding-stuffs which might be effected by the widespread adoption of these various measures. A recent review[3] indicates that such savings would probably amount to nearly a quarter of a million tons of protein equivalent and to more than a million tons of starch equivalent, that is, to more than a fifth of the estimated total feeding-stuffs gap.

New sources of supply and the more economical use of existing supplies together might, therefore, make good about half the pre-War imports of feeding-stuffs. The extent to which the third measure, a compulsory reduction in the live-stock population, would be necessary would then clearly depend on the level at which feeding-stuffs imports could be maintained during the War period. Up to the present, the supplies which have been released by the Ministry of Food have not fallen below the 50 per cent level, though the first preference accorded to certain classes of stock, notably milking cattle, has involved particular hardship on many breeders of pigs and poultry. If imports were to fall consistently below the 50 per cent level, a reduction in the live-stock population would be inevitable, for there is no more wasteful method of utilizing feeding-stuffs than by dissipating them in the maintenance of an excessive live-stock population.

In deciding on the classes of stock to be reduced, and on the extent of such reductions, a number of factors would require to be taken into account. Among these would be the relative food values, for the human population, of the various animal products produced by each class of stock, the extent to which the imports of such animal products were themselves reduced, the relative efficiencies with which the different classes of stock could convert feeding-stuffs into human food, and finally the maximum rates of reproduction and therefore the potential rates of replacement of the depleted flocks and herds in the post-War period. Any detailed discussion of these points would, however, be outside the scope of the present article.

[1] Wright, N. C., "The Importance of Home-Produced Feeding-Stuffs", *Trans. Highland and Agric. Soc.* (1938).

[2] Wright, N. C., "Britain's Supplies of Feeding-Stuffs", *Empire J. Exp. Agric.* (1940).

[3] Wright, N. C., "Britain's Feeding-Stuffs Gap: Can it be Closed?", *Agric. Progress* (1940) (in press).

[4] Beharrell, J., "Kitchen Waste for Feeding Farm Stock", NATURE, **146**, 47 (July 13, 1940).

CHEMISTRY AND HYDROGRAPHY OF LAKES TANGANYIKA AND NYASA

By R. S. A. Beauchamp

"JOHN MURRAY" Expeditions to Lakes Tanganyika and Nyasa have recently been undertaken in order to discover the chemical and hydrographical conditions obtaining in deep tropical lakes, and in the hope of explaining the faunal peculiarities of Lake Tanganyika.

The lakes are situated south of the equator in the African Rift Valley; both are approximately 400 miles long and 30 miles wide. Their long axes lie north and south, and their maximum depths are approximately 1,400 m. and 800 m. respectively. Superficially, they appear to be similar, but their fauna and flora are very different[1]. Seventy-five per cent of the species which make up the fauna of Tanganyika are peculiar to that lake, whereas the majority of species in Nyasa are common to other African lakes, or of world-wide distribution. The species peculiar to Tanganyika, notably the molluscs, resemble in many respects marine species. This led to Moore's theory[2] that at one time Tanganyika was connected with the sea, but geological evidence is entirely opposed to this theory. Later, Cunnington suggested that during an arid period the Lake contained a greater concentration of salts which led to the evolution of species resembling marine types. The research expedition has suggested an alternative explanation (see later) and supplied evidence against Cunnington's theory. I have given an account of the hydrology of Lake Tanganyika elsewhere[3].

Certain generalizations must be made to give point to what follows. Apart from the geographical situation of a lake, which determines the average temperature of the water and the quantity of sunlight, the biological productivity of any lake is largely determined by the amounts of nutrient salts present in the surface waters. These salts are supplied by decomposition of the bottom deposits, and by inflowing streams. The relative importance of these two sources of supply will vary from lake to lake, but usually the bottom deposits are the most important source. This is particularly so in such lakes as Tanganyika and Nyasa, where the volume of the inflows is very small indeed as compared with the volume of the lake. In Tanganyika the annual inflow is approximately equal to one two-thousandth of the volume of the lake, in Nyasa to one six-hundredth. Hence the biological productivity of these two lakes is mainly determined by the supply and transport of salts originating from the bottom deposits. These salts can be of no use until they are brought to the surface, where they can be utilized by the phytoplankton.

In shallow lakes, currents caused by winds may lead to complete circulation and complete mixing of the bottom and surface water, but in deep lakes this can only occur during the winter, when the whole lake is brought to a uniform temperature; in very deep lakes complete circulation may never be brought about. During the summer, the surface waters on warming become less dense and remain on a discrete layer, the epilimnion, which lies on top of the deeper cooler layer, the hypolimnion. Little or no mixing may occur between these two layers, with the result that the salts in the epilimnion may become depleted by the phytoplankton, though considerable quantities may be present in the deeper water. Conversely, oxygen may be abundant in the epilimnion and completely absent in the hypolimnion. From this it is evident that the abundance of the phytoplankton, and the abundance and distribution of the zooplankton and bottom-living animals in deep lakes are determined by the degree to which the epi- and hypo-limnion are differentiated, and the length of time these layers are maintained. Tanganyika and Nyasa are markedly different in these respects.

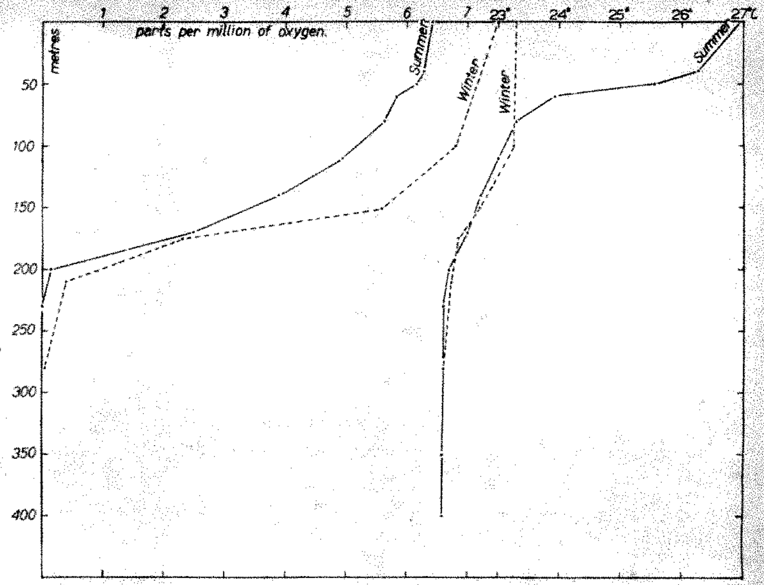


Fig. 2.

LAKE NYASA.

The position and extent of layers can be illustrated graphically by plotting the temperature and chemical composition of the water at various levels. The transition from one layer to the next is marked by sudden changes of temperature and in amounts of dissolved salts and oxygen. A discussion of the amounts of nutrient salts present in these two lakes is beyond the scope of this article; it must suffice to say that silicates may vary from 0·2 to 1·0 parts per million in the surface water, while the deep water may contain 20 parts, that corresponding differences occur in the amount of phosphates, nitrates, etc., and that the deep deoxygenated water contains considerable quantities of ammonia and hydrogen sulphide.

Figs. 1 and 2 show dissolved oxygen and temperature values for Tanganyika and Nyasa respectively. The continuous lines show values during the period of stability, the dotted lines during the period of maximum mixing. It can be seen that in the summer months there is a far greater temperature difference between the epi- and hypo-limnion in Nyasa than in Tanganyika, the deep water being one degree cooler, and the surface water on an average one degree warmer. In spite of this, considerably more mixing of the two layers occurs in Nyasa, as can be seen from the fact that oxygenated water has been carried down far below the thermocline, while in Tanganyika it does not penetrate below the thermocline. (The thermocline is the discontinuity layer between the epi- and hypo-limnion.)

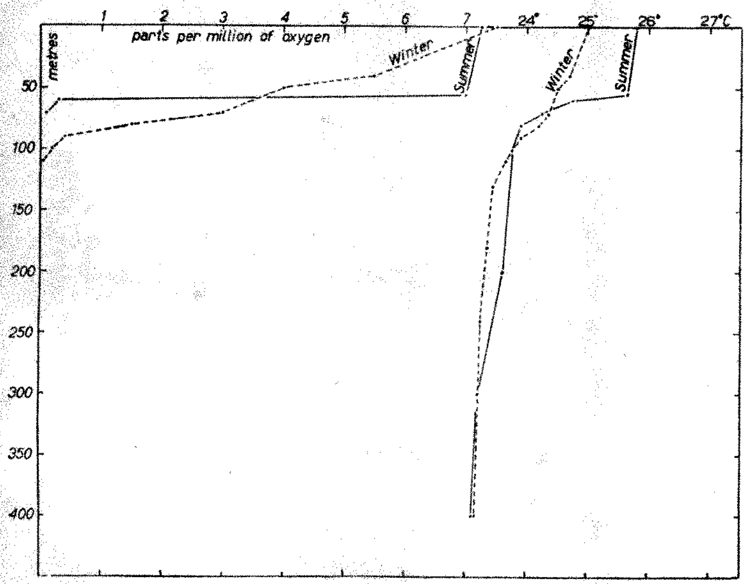


Fig. 1.

LAKE TANGANYIKA.

The explanation of this effect lies in the entirely different weather conditions which obtain in the two areas. In summer, Nyasa receives stronger and more variable winds, in winter much stronger winds than Tanganyika. This is because Nyasa lies farther south than Tanganyika, and nearer the coast, and so during winter (April to September), feels the full effect of the south-east trade winds. These, locally known as the *Mwera*, blow with extreme violence, often for days on end, though usually abating at night. Thus a high degree of mixing of water in the lake occurs throughout the winter, penetrating deeper as the temperature gradient is lowered. Tanganyika being farther north, and being protected by the Southern Highlands, does not receive the full force of these winds, and very much less mixing occurs. In the summer months both regions are characterized by thunderstorms and rain, with variable winds mainly from the north or north-east, but in Nyasa the winds are both stronger and more variable than in Tanganyika.

It has been shown[3] that sudden changes in wind direction cause more mixing than steady winds. When winds blow steadily over a lake, a current is formed which circulates in the epilimnion. This induces a secondary current in the hypolimnion; the two currents remain distinct, and, in the region of the thermocline, flow in the same direction, causing little or no mixing between these two layers of water. A sudden change in wind direction, however, will reverse the direction of rotation of the epilimnial current, with the result that it now opposes the hypolimnial current, causing turbulence at the thermocline, and mixing between epi- and hypo-limnion. Thus the constant changes of wind direction during summer cause in Nyasa a considerable amount of mixing in spite of the fact that the temperatures of epi- and hypo-limnion differ greatly.

It might seem that any oxygenated water which finds its way below the thermocline will become mixed with the whole of the hypolimnion. Actually, this is not the case. It was found on occasions that the hypolimnion was divided into two or more layers. This is a matter of extreme importance. If the available oxygen in the upper limits of the hypolimnion were to be distributed throughout the whole volume of the hypolimnion, it would be impossible to maintain an oxygen concentration in it sufficient to support the life of the deep-living animals. But as the available oxygen is only distributed through part of the hypolimnion, sufficiently high values are maintained in this part to support life.

Differences in temperature and chemical composition between layers in the hypolimnion may be slight, which makes them difficult to observe from a single set of samples. But these layers become distinct when values for dissolved oxygen on consecutive days are plotted on the same graph. This is because the currents in each of the various layers tend to make each layer more homogeneous. This shows as a decrease in the amount of dissolved oxygen in the upper portion of each layer and an increase in the lower portion on the later date. Fig. 3 shows this effect. It will be seen that the oxygen curve for February 23 repeatedly crosses the oxygen curve for February 21. The areas enclosed by these two curves indicate a decrease and increase in oxygen content in the upper and lower portions respectively of each layer. The upper 250 m. of the lake is clearly divided into four layers; this discontinuity between these layers being also shown by the temperature curve. The transfer of oxygen to lower levels is demonstrated, as we would naturally expect; this can only be done at the expense of the upper layers. It should be noted in this connexion that the surface waters of Nyasa during the summer contain less oxygen than those of Tanganyika. Later a change in wind direction upsets the layered condition described above, and mixing occurs between each of these layers. This layering of the hypolimnion had previously been suggested on theoretical grounds, but has not hitherto been so clearly demonstrated.

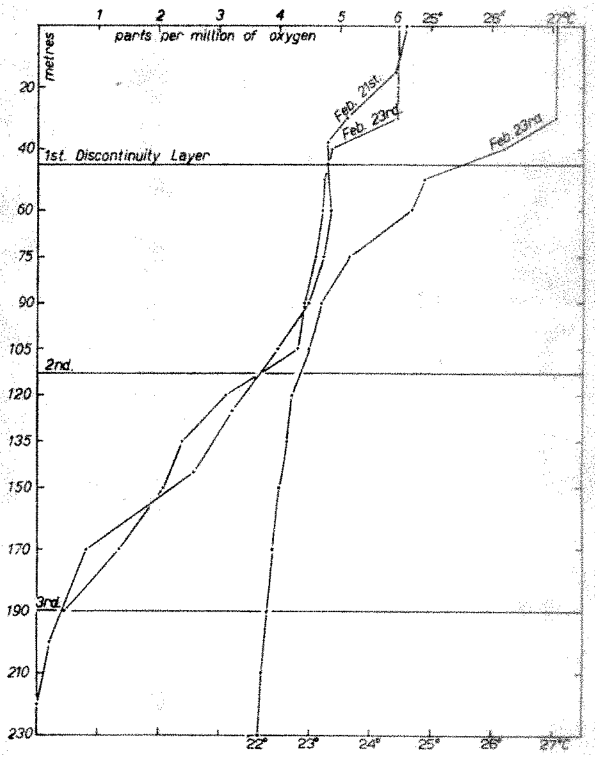


Fig. 3.

Space does not permit of details concerning the density of the plankton, or the length of the productive period in these two lakes, but as we would expect from the above data, Nyasa is a much more productive lake than Tanganyika. During the long period of stability in Tanganyika, plankton development is very greatly restricted. This is due apparently to a shortage of nutrient salts, probably nitrates in particular. At the end of the winter when mixing occurs, the phytoplankton starts to increase and is followed by an increase in zooplankton. In Nyasa, however, during the latter part of the winter when the *Mwera* is still blowing strongly, plankton development is slight, but as soon as the winds become less strong and a degree of stability is established, the plankton starts to increase rapidly. In this case it appears that plankton development is restricted, not by any shortage of salts, but by the too violent mixing of the surface waters. It may be supposed that phytoplankton is continually being carried down to depths in which photosynthesis is no longer possible. The evidence for this is not conclusive, but a parallel may perhaps be found in what occurs in the sea.

With regard to bottom-living fauna, Tanganyika cannot support an animal population below the level of the thermocline because of the lack of oxygen, but Nyasa does; notable among these forms are the Chironomidæ, which occur in enormous numbers. The adult Chironomids, on emergence, are swept into dense clouds and are carried often thousands of feet into the air by the 'thermals' which cause the offshore winds. These clouds of 'Kungen fly', as they are called, form a remarkable feature of Lake Nyasa, looking like two lines of bush fires occurring at intervals, along the length of the Lake seven to ten miles out from either coast. They usually appear very shortly after a period when mixing has led to an increase in the oxygen content of the deeper water. Sometimes these enormous swarms are blown on to the shore, when the natives, swinging baskets through them, collect enough of them to make compressed cakes, which are eaten with considerable relish.

Finally, certain peculiarities concerning the chemical composition of the waters of Tanganyika are important. It was found that the Lake contains relatively large amounts of potassium and magnesium. This is due partly to the natural accumulation of these salts, which is to be expected in a lake from which the main loss of water is by evaporation, and partly to the large amounts of these salts brought in by the Ruzizi. The Ruzizi flows into the north end of Tanganyika and is the outflow from Lake Kivu. These values, thirty-three and forty-four parts per million for potassium and magnesium respectively, may have caused the development of some of the species peculiar to this lake.

It was also found in Tanganyika that, though the total amounts of dissolved salts in the Lake are normal for fresh waters, the ratios of the amounts of magnesium to calcium and chloride to sulphate are high and resemble those found in sea water. As the inflowing waters do not show these proportions, they would seem to have been brought about by biological activity. For example, the molluscan fauna precipitates calcium, thus keeping its concentration low, while leaving magnesium to accumulate. Conversely, though this is certainly less important, the paucity of the flora, particularly the littoral flora, may result in an abnormally low rate of utilization of magnesium.

The high ratio of chloride to sulphate is not quite so simply explained. The low concentration of sulphate, which in the Lake is actually less than it is in the inflows, is presumably due to the removal of sulphur in the formation of all organic matter. On the other hand, though chlorides are essential for life, little chlorine is actually chemically combined to form organic matter. Hence chlorides are easily liberated from the bottom deposits. But sulphur, which is chemically combined in many proteins, is not easily liberated and appears mostly as hydrogen sulphide. Even then much of this hydrogen sulphide is probably precipitated again chemically as insoluble sulphides of copper and iron. Consequently, sulphates are continually being removed, either as undecomposed organic matter or as insoluble sulphides, while chlorides accumulate.

These and similar processes which alter the composition of lake waters occur to some extent in all lakes, but the extent to which they can be effective depends on the average length of time spent by water in the Lake. In Tanganyika this is an extremely long time, since the volume of the inflows is small compared with the volume of the Lake. In addition, the outlet from the Lake is small, and ninety per cent of the total inflow, including rainfall on the Lake, is lost by evaporation.

Reasons have been given[3] why the total concentration of salts in Tanganyika is no higher than four hundred parts per million, and why it is considered unlikely that the total concentration was at any time in the past considerably higher than at the present time. I suggest, however, that one of the causes for the marine appearance of a large number of the species found in Tanganyika may be due to the fact that in the Lake the ratios of chloride to sulphate and magnesium to calcium have become similar to those found in sea water. This theory will seem more convincing if a complete analysis of water from Lake Nyasa shows a more usual proportion of these salts. It is hoped that it will be possible later to have these analyses done by the Government Chemist, who kindly carried out the full analyses of samples from Lake Tanganyika.

---

[1] Cunnington, W. A., *Proc. Zool. Soc.*, 507 (1920).
[2] Moore, J. E. S., "The Tanganyika Problem" (1903).
[3] Beauchamp, R. S. A., *Int. Rev. Hydrobiol.*, **39** (1939).

OBITUARIES

Sir George Macdonald, K.C.B., F.B.A.

We regret to record the death of Sir George Macdonald, the distinguished Scottish archæologist, which took place in Edinburgh on August 9 at the age of seventy-eight.

George Macdonald was born at Elgin in 1862, and was educated at Kelvinside Academy and in the University of Glasgow whence, winning the Ferguson scholarship for classics, he passed to Balliol College, Oxford, and graduated with first-class honours in Classical Moderations and Literæ Humaniores. For a few years he was engaged in teaching at Kelvinside Academy. In 1892 he became lecturer in Greek in the University of Glasgow. It was during this period of work in Glasgow that he was attracted to the study of numismatics, and it was not long before he won recognition as an outstanding authority in this subject. For fifteen years he devoted himself to the preparation of a catalogue and the classification of the remarkable collection of coins of the Hunterian Museum. His work was recognized by the Académie des Inscriptions et Belles Lettres by the award, in 1907, of the Prix Allier de Hauteroche. He also became honorary curator of the Hunterian Museum and of the Society of Antiquaries of Scotland, and was elected an honorary member of the Viennese and American Numismatic Societies. His work and his conclusions are summed up in his Rhind lectures on coin types delivered in 1905. In 1913 he was awarded the medal of the Royal Numismatic Society, and in 1921 that of the American Numismatic Society.

Macdonald's pre-eminence as a student of numismatics, though widely recognized, was, after all, mainly of preponderant interest to specialists in that subject, except when, as it tended to do more and more as time went on, his studies impinged upon archæological and historical topics connected with earlier Britain. To both the learned and outside worlds he was known best as classical scholar, an authority on Roman Britain, and a motive force in Scottish education.

In 1904 Macdonald left Glasgow for Edinburgh, where he entered the Scottish Department of Education, of which he became permanent secretary in 1922, succeeding Sir John Struthers. He retired in 1928 after a term of office marked by great activity and advance in Scottish education.

It was in the study of Roman Britain that Macdonald made his most lasting contribution to archæology in the broader sense. His study of coins while at Glasgow had attracted him to the problems of Roman rule and culture. He devoted much study to the Antonine Wall between Forth and Clyde, and not only took part in many excavations himself, but also was largely responsible for the organization of the excavations on Roman sites in North Britain for a period of more than twenty years. To mention a few only of his numerous contributions to the literature of the subject, in 1907 he published a report on the Roman forts at Bar Hill, and in 1911 on the Roman Wall in Scotland. On the death of Prof. Haverfield he was responsible for revised editions of "The Romanization of Roman Britain" and "The Roman Occupation of Britain" by his fellow-worker.

During 1921–26 he was president of the Society for the Promotion of Roman Studies, and in 1928 president of the anthropological section of the British Association at the Glasgow meeting. He served on the Royal Commission on Museums and Galleries in 1927, and the Royal Fine Arts Commission of Scotland in the same year.

Mr. A. H. Case

The death on July 25 last, at the advanced age of eighty-two, of Mr. Albert Havelock Case removes a well-known personality from civil engineering circles in London. Mr. Case, who was a Whitworth Scholar, in addition to being a member of the Institution of Civil Engineers, received his early technical training in the old-established engineering firm of Stothert and Pitt, Ltd., of Bath. After some short service with the French State Railways, he was engaged on the staff of Sir John Coode in connexion with foreshore protection work at Spurn Point and Hastings. Then, under Sir John Wolfe Barry, he was resident engineer on dock constructional operations on the Tyne and in South Wales. Afterwards, he became engineer-in-chief of the Port Talbot Railway and Dock Company. During an association with Trinity House, he was resident engineer for the construction of Beachy Head Lighthouse, near Eastbourne. He also reported on the drainage of the Great Ouse basin.

By this time, Mr. Case was established in private consulting practice at Westminster, holding two appointments as engineer to Commissions of Sewers on the north side of the Thames. Later he was joined in partnership by Dr. Brysson Cunningham, with whom he carried out various land drainage and riverside works in south Essex and north Kent. The firm of Case and Cunningham also advised on port improvements at Montevideo, at Nassau and at Malta.

* * *

We regret to announce the following deaths:

Prof. G. H. Fowler, C.B.E., formerly assistant professor of zoology in University College, London, on August 15, aged seventy-nine.

Count Giovanni Lorenzini, president of the Italian Biochemical Institute at Milan, known for his work on the vitamins, on July 24.

Mr. R. C. Mossman, meteorologist of the Scottish National Antarctic Expedition; since 1920, climatologist to the Argentine Meteorological Office, on July 17, aged sixty-nine.

Mrs. Tyndall, widow of Prof. John Tyndall, on August 19, aged ninety-five.

NEWS AND VIEWS

Science in War Strategy

In his review of the war situation before the House of Commons on August 20, the Prime Minister said: "It is a conflict of strategy, of organization, of technical apparatus, science, mechanics and moral. . . . Moves are made upon the scientific and strategic boards, advantages are gained by mechanical means." On many occasions we have emphasized the all-important part which men of science must play (and, indeed, are playing) in this world conflict of ideals. Just as important is the fact that in most of his speeches and reviews, Mr. Churchill has revealed how alive he and the present Government are to the important contributions of science. "There seems to be every reason to believe that this new kind of war is well suited to the genius and the resources of the British nation and the British Empire." For several years now, Great Britain and the rest of the Empire (together with the United States and other democratic countries) have consistently offered hospitality and opportunity for work to thousands of the victims of the hideous Nazi racial laws. These included many men of science. The ultimate benefit to the cultural life of democratic countries had never needed emphasizing. It was immediate, and it will be lasting. Now the immediate benefit is becoming more and more evident and was stressed by the Prime Minister when he said: "Since the Germans drove out the Jews and lowered their technical standards, our science is definitely ahead of theirs."

Food Policy

The points raised in the leading article beginning on p. 243 have received the fullest support in the Prime Minister's speech. Germany has command of huge food supplies within her own frontiers and in the occupied territories. "The only agencies which can create famine in any part of Europe now and during the coming winter will be German exactions or German failure to distribute the supplies which they command." Furthermore, many valuable foodstuffs, such as fats, potatoes, milk, and so forth, can be used in the manufacture of war materials, such as explosives, motor spirit and plastics. Aid for any stricken country is therefore unthinkable while that country is under German control. This is, of course, a harsh policy to adopt, but it is an essential one. It can be offset, however, as pointed out in the leading article, by reserving foods in preparation for reconstruction after the War. We are now assured that this will be done by the Prime Minister who has said "we can, and we will, arrange in advance for the speedy entry of food into any part of the enslaved area when this part has been wholly cleared of German forces and has genuinely regained its freedom. We shall do our best to encourage the building up of reserves of food all over the world so that there will always be held up before the eyes of the peoples of Europe, including—I say it deliberately—the German and Austrian peoples, the certainty that the shattering of the Nazi power will bring to them all immediate food, freedom, and peace".

Man-power of the Nation

Some words uttered by Sir William Beveridge in the course of a broadcast address on the recent Industrial Registration Order referring to engineers are applicable outside the strict context of the address. He emphasized that registration does not mean that workers will be taken off their jobs immediately and put to other jobs. The first object of registration is to obtain a survey of the position so far as available man-power is concerned. Having obtained such a statement, it is possible to consider the re-allocation of individuals in such a way that the war-time needs of the nation receive first consideration. Sir William also pointed out that, even after this survey, many workers will of necessity still be left in jobs which are not obviously of direct use in the national effort. "If after registration we leave a man where he is, he can feel satisfied that he is doing his duty there," Sir William said, and that must be the consolation of many who are denied more spectacular achievement. This Industrial Registration Order is "part of a general plan to ensure that all the brains and muscles of the nation are used in the right way, so that there is no waste and no injustice". Such a general plan will command widespread support, the only regret being that it was not initiated many months ago before the present intense stage of the conflict had been reached. It should be carried through speedily and put into effect at the earliest possible moment.

Political Issues in India

Those, if any there be, who may feel surprised at the reluctant, not to say sluggish, reaction of opinion in India to the terms of the Viceroy's proclamation on present and future conditions affecting the constitutional issue, will do well to examine with care the masterly and statesmanlike analysis of the elements of the deadlock and the effect of the Viceroy's proposals, both now and as regards the future, presented to the House of Commons on August 14 by Mr. L. S. Amery, Secretary of State for India. The differences, as he pointed out, are not between the British Government and the Indians, but those which exist among the Indians themselves —on one side, the Congress party, which has sought to make itself the national party, and would wish to speak for India as a whole; on the other, to name the three elements only to which Mr. Amery referred, the ninety million Moslems, the scheduled castes who stand outside the main Hindu community represented by Congress, and thirdly, the Indian princes whose territory covers a third of all India. These differences are based upon a long and powerful tradition rooted in religious belief and social regulation. They are, Mr. Amery said in speaking more particularly of the Muhammadans, "as deep as, if not deeper, than any similar differences in Europe". Because they impinge upon what is most vital in the life of the people, namely, their religious beliefs and cultural beliefs, and because they are faced with the familiar urge of Hinduism to absorb and assimilate, they emerge in the form of a profound mistrust of majority rule.

Mr. Amery himself does not despair of the situation. As he told the House, he does not regard the differences between these conflicting elements in India, which have been the subject of negotiation since October last, as unbridgable. That in actual practice they may be bridged is shown by the co-operation of individual members of the Moslem community, who have taken an active part in the work of the Congress party. In the main, however, he relied upon two factors. In the first place, whatever may be the barriers between the component elements, India is a distinct cultural unity, a self-contained and distinctive region of the world, boasting an ancient civilization and a long history common to all her peoples, of which all Indians were equally proud; and secondly, all parties are at one in their detestation of Nazi aggression and their endorsement of our common cause. Common effort in the present emergency and the opportunity for discussion and the promotion of understanding pending post-War deliberations cannot but strengthen these two forces making for unity, and help to bring about that readiness to accept agreement based upon compromise of rule by consent which is "the foundation of all free government and of all true democracy". By India's aptitude in displaying these qualities in the immediate future will her full and free acceptance of the democratic ideal be judged.

Causes of Accidents in Factories

EVIDENCE submitted by the National Federation of Professional Workers before the Royal Commission on Workmen's Compensation on May 16 calls for a revision of the maximum benefits payable and attaches great importance to replacing the flat rate maximum by payments proportionately related to earnings already recognized in the payments for partial incapacity. It was also urged that there is no justification for such a salary limit as exists at present. The Federation expressed the opinion that extension of the salary limit or its entire elimination would not upset the structure or balance of the Act. It was further urged that compulsory insurance should be extended to all classes of employment and the doctrine of common employment abolished as a defence against claims under the common law.

In a memorandum of evidence submitted it was stated that the majority of accidents in factories occur owing to the negligence of employees, and in an examination on this memorandum the representatives of the National Federation of Professional Workers stated that in many engineering concerns most of the accidents are due to negligence or, what was worse than negligence in a sense, some breach of statutory regulations or statutory duties. The failure of the material is often a matter of negligence at some more remote period and the Federation's conception of negligence was that it began in the Board Room. Breakdown of material, for example, could generally be attributed to failure to inspect sufficiently frequently, and in very busy works a good deal was taken for granted without inspection. It is considered that many safeguards could be arranged as an integral part in the design of the machine, and that is increasing in many makes of machinery. It was urged that much could be done in the drawing office rather than after the machine is installed to prevent accidents.

In explaining that the majority of accidents in factories occur owing to the negligence of employees, it was held that accidents are not caused by the negligence of the injured employee and this was linked up with the doctrine of common employment according to which where an injury arises owing to the negligence of a fellow employee the injured man cannot take an action. Apart from what one might call natural accidents it was safe to say that every accident occurs through some human agency. Much negligence, it was brought out in further evidence, was not necessarily culpable but might be due to fatigue. The Federation did not agree to a distinction between accidents due to the negligence of a manager or someone in special authority under a manager and accidents due to the negligence of the ordinary fellow worker. It is considered reasonable to hold the employer responsible for damages even when the negligence was not on the part of any official but on that of a fellow worker.

Blow-Guns for Clearing Away Dust in Factories

ACCIDENTS occur every year as the result of attempts to clear away dust, etc. by hand from moving machinery or electrical apparatus. Using rags or brushes for this purpose is often very dangerous. According to *Engineering* of July 26, pneumatic blow-guns are proving very useful for this purpose. They weigh only half a pound and are easily handled even in very awkward positions. The blow-gun is intended for use in workshops where compressed air is available, and below the hand-grips it has a hose connexion. The body is of aluminium and the renewable nozzle is of bronze. The nozzle can have a bore of $\frac{1}{16}$ in., $\frac{1}{8}$ in. or $\frac{5}{32}$ in., as desired. If used near live electrical fittings, it is made of insulating material so that safe operation is assured if accidental contact is made. Control of the air jet is effected by a push button actuated by the forefinger of the hand holding the gun. The valve is readily renewable.

It is stated that the blow-gun has proved most useful in blowing dust from foundry moulds and is particularly effective in getting rid of the dust formed in machining operations in non-metallic materials, such as plastics, this dust being difficult to displace by means of brushes or rags. In wood-working machinery it is very useful in removing sawdust and shavings. To enable the gun to be readily connected to existing air supplies, the manufacturers have developed a neat pressure-reducing tube valve manufactured from bronze pressings and having a diaphragm of the oil-resisting rubber insertion type. The valve will reduce an initial pressure of 150 lb. per sq. in. to any pressure between 5 lb. and 100 lb. per sq. in., the adjustment being made by a thumb screw. The valve has a nickel-plated finish and is stated to be unaffected by oil or water and does not vibrate or chatter when in use.

War, Tradition and Natural Beauty

IN a war, which in so far as the greater includes the less, is being fought by the British people in defence of an ideal of the spirit which, we maintain, has run like a thread throughout our history, it is vital that every effort should be made to keep alive, even if necessary in attenuated form, activities which make for the preservation of the national tradition as embodied in our antiquities and places of historic interest, or in those vistas of our landscape which are not only beautiful in themselves, but also express something which is essentially in harmony with characteristics of the mentality of the British peoples. The recent pronouncement of the Council for the Preservation of Rural England makes a bold bid to reconcile claims arising out of present necessities with its objective of saving rural beauties from desecration.

How difficult this may become is strikingly illustrated in the recently issued report for 1939–40 of the National Trust. Here and there in the brief notes on the properties held by the Trust a hint is given of the difficulties which are being, or have had to be, overcome by those responsible for carrying out the objects of the Trust in securing that these objects shall not be irrevocably overridden, if that is at all possible, by the requirements of military authority or the necessities of food supply. The normal expansion of the work of the Trust cannot be expected to continue unimpaired in present conditions; and indeed the annual report for the period under review chronicles a reduction in receipts, not, indeed, as great as might be anticipated, which will make the realization of even working costs a matter of some anxiety. The work of the Trust, however, is, as has been said, of vital importance in maintaining much that is of the best in the national tradition, and its claims to public support should be among the last to be overlooked. An indication of the activity of the Trust in recent years is afforded by a comparative table given in the annual report, which shows that in the period 1914–40 there has been a tenfold increase in most of the figures. The number of properties has increased from 63 to 410, the acreage from 5,814 to 58,900; the capital raised and expended from £59,861 to £530,114, subscriptions from £559 to £6,193, and the gross income from properties from £1,461 to £27,553.

Preserves from the Garden

"GROWMORE" BULLETIN No. 3, of the Ministry of Agriculture and Fisheries (H.M. Stationery Office, 4*d.*), presents in a concise and practical form instruction for the housewife in the preservation of surplus fruit and vegetables for winter use. Full directions are given for the making of jams, fruit jellies, cheeses, and syrups, and the bottling and canning of fruit and vegetables. Instructive notes are provided on the peculiarities of particular fruits and their suitability for the various methods of preservation. A selection of recipes for jam and jelly made from the more important fruits is included, and in some of these the normal amount of sugar has been reduced to meet the difficulties of sugar shortage. A useful feature is a statement of the expected yield of jam from the amounts of fruit used. Various methods are given for sterilizing fruit for canning and bottling and the preservation of fruit in the form of pulp. The latter is a useful method for the storage of large quantities of apples and plums without sugar.

The preservation of vegetables is not so widely practised as that of fruit, and as pressure cookers are recommended for vegetable sterilization, this method will not be extensively used in the average household Several vegetables may, however, be preserved by pickling, which is briefly dealt with in the bulletin. Salted runner beans are invariably satisfactory, and as salt is cheap and the method simple, more use should be made of this usually prolific crop. Many fruits and vegetables can be dried for future use, a method which needs no preservative, and is adequately treated in this bulletin. The authors, Alice Crang and Margery Mason, have produced a very usable handbook, and are to be congratulated on the selection of the most useful and straightforward methods, as well as on the omission of technical details which are of little interest to the average housewife.

Organized Labour in Germany

ALTHOUGH written rather as if to prove a point, Dr. W. A. Robson's pamphlet, "Labour under Nazi Rule" (Oxford Pamphlets on World Affairs, No. 33. Pp. 32. Oxford: Clarendon Press. 3*d.* net) gives a concise and lucid account of the sweeping changes made by the Nazi regime in the status and organization of labour, from the liquidation of the highly progressive German working-class movement in 1933 to the system of unmitigated industrial conscription introduced since 1938. Prior to 1933, Germany was one of the most progressive countries in the world so far as the position of organized labour was concerned. By showing the extent to which industrial servitude and regimentation have been exacted as the price of Hitler's achievement in abolishing unemployment, Dr. Robson puts that achievement in its true perspective along with the Labour Front and the 'Strength through Joy' movement. This admirably written account of the present position of organized labour in Germany and the way in which it has arisen fully substantiates Dr. Robson's central thesis that the status, freedom, power, and conditions of work of the employed workers in Germany have deteriorated to an almost inconceivable extent under the Nazi Government.

Supply of Electric Torches

THE supply of pocket torches for the coming winter months is already being discussed by wholesalers and manufacturers. According to the *Electrical Times* of August 15, the evidence as to shortage or abundance is conflicting. Manufacturers at present are said to be rationing supplies to the wholesalers rather severely. American torches are difficult to obtain owing to import licences being withheld. Belgian and Dutch torches have disappeared completely. Any bulk supplies received are got rid of very readily. The public grew so accustomed to using these handy little accessories last winter that they are now buying them quite briskly although the long summer daylight hours render them unnecessary. Many hope that the various restrictions will be relaxed with the approach of winter. If this happens, the machinery of home production has been increased so extensively that maintenance of a steady and adequate supply will become possible. Much depends upon the Government's attitude towards raw materials. This authority urges the public to hold off purchasing until the late autumn, for batteries are not things that can be held in store without rapid deterioration, especially if kept in damp places. Others hold a more optimistic view. They point to the great strides taken by manufacturers to increase production to such an extent that the disappearance of foreign-made torches will more than be made good before next winter sets in. Supply firms, it is reported, are confident that the rush demand of last winter will be less severe and that all wants will be steadily met although there will be a slight increase in price.

Greenkeeping Matters and the Gall Midge of Grasses

THE Board of Greenkeeping Research has adapted its research station at St. Ives, Bingley, Yorks., to war-time conditions. Some of its new activities have already been mentioned in these pages, and the first war-time number of the Board's *Journal of Greenkeeping Research* (6, No. 21, from the Director, price 3*s*. 9*d*. per copy post paid) contains a number of short papers which deal further with the altered needs of the present time. The Station's director, Mr. R. B. Dawson, outlines the general war-time policy of linking golf grounds with food production so far as possible, and Mr. R. B. Ferro describes "War-time Turf Policy" from the point of view of minimal attention without permanent damage. There is a very useful survey of gall midge damage to grass seed by Mr. H. F. Barnes of Rothamsted Experimental Station. Many species, mostly of the genera Dasyneura and Contarinia, are shown to have specialized relations with a number of separate grass hosts. The damage done to seed plots must be very great, but seedsmen are now willing to pay more attention to their crops. Mr. Barnes considers the possibility of biological control through the selection of early or late maturing strains of the various host grasses to avoid the period of egg-laying. The present number of the *Journal* also contains notes and abstracts of a number of papers and matters of interest to those who have to deal with grassland.

Swordfish Attacking Vessels

SINCE the seventeenth century, authentic accounts are on record of the spearing of ships by the swordfish (Xiphias) and its relatives the spear- or marlin-spike-fishes (Makaira) and the sail-fishes (Istiophorus). The stories of these attacks, their effects and their causes, with much incidental information, have been gathered together and discussed in a 100-page monograph, illustrated by seven plates and several text-figures, by Dr. E. W. Gudger (*Mem. Roy. Asiatic Soc. Bengal*, 12, 215–315; 1940). The attacks, which have occurred in all parts of tropical seas, are delivered with force, for not only have ships been shaken from stem to stern by the blow, but also the penetrations recorded include the piercing of the copper covering, a 4-inch birch plank, and 6 inches of the timbers of the brig *Tinker* of New York, and the remarkable case of the South Seas whaler *Fortune* of Plymouth, Mass., the timbers of which beneath their copper sheath were penetrated through 18·5 inches of hard wood, 14·5 inches being of dense oak. The speed of the swordfishes is, however, great, and that together with the size of the fish, which may weigh 1,200 lb. (Zane Grey's marlin), and the fine lines of the sword itself, accounts for the power and effect of the blow. The author describes the fishes as timid rather than pugnacious, and concludes that the attacks are generally made either by fishes which have been wounded and are dashing about in pain and fright, or inadvertently when the fishes are, particularly in darkness, following and attacking a shoal of fishes upon which they are preying.

High-Speed X-Ray Photography

SHADOW photographs taken with an exposure short enough to show a moving bullet while passing through a block of wood were shown and discussed at a meeting of the American Physical Society held on June 21. According to a Science Service report, the photographs were taken by using a very brief electrical surge of high voltage and amperage got by charging a condenser in several seconds, and then discharging it through the X-ray tube. For the short space of time necessary to take the photograph, the new tube will carry a current of about 2,000 amperes at 100,000 volts. In photographing rapidly moving objects, a fine tungsten wire connected in the timing circuit is broken by the moving object so that the energy stored in the condensers is released at the correct instant. Possible applications discussed were the use of the method to study internal strains in rapidly moving machine parts and in the bones of the body in vigorous action. The new X-ray tube and technique have been developed in the Westinghouse Lamp Division by Dr. C. M. Slack and his associates.

T'ang Pottery for the British Museum

A REMARKABLE example of T'ang pottery, well known to collectors and students, from the collection of the late Mr. George Eumorfopoulos, has been given to the British Museum by his widow to mark his long and close friendship for that institution, of which he was a generous benefactor. The gift is a pottery model of a saddled horse. It stands just under a foot high, and is an outstanding example of the technical skill and artistic feeling of the Chinese under the T'ang dynasty. This period (A.D. 618–905) was one of the most remarkable in the history of the Chinese Empire. A consolidation and expansion of the imperial power after a time of stress, combined with a revival in the spirit of Buddhism, inspired from its sources in India by the pilgrimages of Chinese priests, to give birth to a remarkable achievement in all forms of the plastic arts, but more notably as exemplified in pottery figures from tomb burials and in the paintings such as those collected in large numbers by Sir Aurel Stein and those who, after him, visited the Buddhist cave shrines of Tun-Huang. The piece of pottery which has now been given to the British Museum was for long highly prized by its former owner and was his favourite specimen. It is known as the 'Blue Horse' on account of the extensive splashing of blue on its glaze, which makes it unique among figures from the tomb burials which are the main source of our knowledge of this type of art in the period.

Racial Characters in Ancient India

EXAMINATION of a skull from Chanhu-Daro, a site of the Indus Valley civilization in northern India, by Dr. Wilton M. Krogman, of the University of Chicago, it is stated in a communication circulated by Science Service of Washington, has demonstrated a combination of characters more usually to be assigned to diverse racial types. The skull in question is that of a young female and had been placed in a jar after decapitation. It is thought that it may have been that of a princess or priestess. It was found in the course of the excavations now being carried out by an expedition of the Boston Museum of Fine Arts, and has been dated as belonging to a period some five thousand years ago. Dr. Krogman's report indicates a combination of such negroid characters as a flattened head vault, broad nose opening and low eye-sockets with Caucasoid features such as narrow nasal bones, small teeth, and narrow distance between the eyes, as well as in the shape of the palate. His conclusion is that it represents "a proto-Mediterranean type in which ancestral negro traits have manifested themselves" and he goes on to suggest that the modern Mediterranean race may once have had a mixture of negroid blood which has since been eradicated.

Children under Foster Care

THE July number of the *Journal of Psychology* contains an interesting study of children under foster care by James W. Layman, of the Mental Health Service, Des Moines, Iowa, based on the examination of eighty-three children. Each of the homes to which the children were admitted was investigated with reference to its environment, physical condition, family history of both boarding parents, financial security of the home, family home life, interests and recreation. The original problems presented by the children included high frequency of lying, truancy, petty stealing, enuresis, timidity, aggressiveness, school maladjustment, larceny of motors, and housebreaking. The age of the children at the time of admission to the homes ranged from six to sixteen years. The outlook was most favourable in the case of the younger children, while the least favourable prognosis was presented by the older children in whom family backgrounds showed a high degree of instability.

Vital Statistics of the United States

THE summary of vital statistics of the United States for 1938, recently published (*Public Health Rep.*, 55, 933 ; 1940), gives the following information. There were 2,286,962 births and 1,381,391 deaths, giving a birth-rate of 17·6 and a death-rate of 10·6 per 1,000 population. Of the total deaths 116,702 were of infants less than one year of age, giving an infantile mortality of 51·0 per 1,000 live births. There were 25,644 sets of twins, 262 sets of triplets and 1 set of quadruplets as compared with 24,881, 219 and 4 respectively in 1937. There was a net natural increase of 7·0 per 1,000 population, the largest since 1930. The infantile mortality rate has shown an interrupted decline from 68·7 in 1928 to 51·0 in 1938, while the maternal mortality rate has fallen continuously during the eleven-year period from 6·9 to 4·4. As regards the causes of death in infancy, premature births stand highest in the list, while pneumonia, diarrhœa and enteritis and congenital malformations come next in the order stated. The cancer death-rate in the United States has risen from 104·1 in 1934 and 112·0 in 1937 to 114·6 in 1938. The deaths from motor accidents in the United States in 1938 (23·5 per 100,000 population) was the lowest since 1923 (23·3). In 1937 the rate was 28·8.

Isis and *Osiris*

THE publication of *Isis*, an international and polyglot quarterly devoted to the history and philosophy of science, was begun in Belgium in 1912–13. Five issues had appeared when the publication was stopped by the German invasion. After the War, publication was continued, the journal being edited in the United States, but printed in Brussels, later in Bruges. In 1924, the History of Science Society was founded in Boston, Mass., in order to guarantee and promote the publication of *Isis*. During the past sixteen years, no less than twenty-five volumes of the journal have been published. With the invasion of Belgium this year, publication was again interrupted. The editor, Dr. George Sarton, Mass., informs us that No. 84 (completing vol. 31) of *Isis* and No. 85 (vol. 32) were ready for press, and it is hoped to issue at least No. 84 this year. Inquiries should be sent to the secretary-treasurer of the History of Science Society, Dr. H. R. Viets, 8 The Fenway, Boston, Mass. From 1941 on (vol. 33 ff.) *Isis* will be printed in the United States. The first American number will include a list of all the papers and reviews which were to have appeared in No. 84 and vol. 32. *Isis* as prepared in America will probably be smaller than that of its Belgian predecessor, but the editorial policy will remain essentially the same. As regards *Osiris*, which was founded in 1936 in order to relieve *Isis* of the longer papers, it is not supported by the History of Science Society, and hence subscriptions to it or correspondence relative to it should not be addressed to the Secretary of the Society, but to Dr. Alexander Pogo (Harvard Library, 189, Cambridge, Mass.). At the time of the German invasion of Belgium, two volumes of *Osiris* were being printed, namely, vol. 8, dedicated to Paul Ver Eecke, historian of Greek mathematics, and vol. 9, dedicated to Max Meyerhof, historian of Arabian medicine. These two volumes will appear in due course. Vol. 7 is reviewed on p. 247 of this issue of NATURE.

July Earthquakes Registered at Kew

DURING July 1940 ten strong earthquakes were registered at Kew. Most of these were at a considerable distance, and five gave ground movement at Kew of greater amplitude than 10 μ. The greatest was on July 30, registered at 17m. 49s. past midnight G.M.T., which gave an amplitude of 45 μ at Kew. This shock had an epicentre some 3,020 km. distant from Kew and was the earthquake near Yozgad in Turkey (NATURE, August 10, p. 196). The earthquake with the greatest depth of focus which occurred during the month was on July 10, with a provisionally estimated depth of 600 km.

Scholarships in Agriculture

ON the recommendation of the Agricultural Research Council, the following awards have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: Ivor Isaac, University College, Swansea, a three-year research scholarship in plant pathology; J. S. Perry, University College of North Wales, Bangor, a three-year research scholarship in zoology; D. McFarlane, Glasgow Veterinary College and University of Glasgow, a studentship for research in animal health.

Awards in Engineering

THE following scholarships for 1940 have been awarded by the Institution of Electrical Engineers: *Duddell Scholarship*, annual value £150, tenable for 3 years, to D. LaW. W. King (Northampton Polytechnic); *Silvanus Thompson Scholarship*, annual value £100, plus tuition fees, tenable for 2 years, 1938 award to H. Darnell (University of Liverpool) renewed for a third year, no new award made this year; *William Beedie Esson Scholarship*, annual value £100, plus tuition fees, tenable for 2 years, renewable in approved cases for a third year, C. H. Bickerdike (London and North Eastern Railway Co.); *David Hughes Scholarship*, value £100, tenable for 1 year, J. H. Nicoll (Merchant Venturers' Technical College, Bristol); *Salomons Scholarships*, value £60, tenable for 1 year, H. H. Rosenbrock (University College, London); value £40, tenable for 1 year, P. H. W. Whyman (University College, London); *Thorrowgood Scholarships*, annual value £12 10s. each, tenable for 2 years, R. J. Post (London Passenger Transport Board), R. P. Gasson (Southern Railway Co.). No award of the Ferranti or Swan Memorial Scholarships or of grants from the War Thanksgiving Education and Research Fund have been made this year.

The following awards have been made by the North East Coast Institution of Engineers and Shipbuilders: Institution Scholarship (£100) to Ian Welsh Goodlet, an apprentice of Messrs. R. & W. Hawthorn, Leslie & Co., Ltd., St. Peter's Works, Newcastle-on-Tyne; bursary of £50 to Eric William Simpson, an apprentice of Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne; M. C. James Medal to Mr. H. J. Tapsell, of the National Physical Laboratory, for his paper on "Creep at High Temperatures"; Thomas Fenwick Reed Medal to Mr. Harry Chilton, now at sea, previously with North Eastern Marine Engineering Co. (1938) Ltd., Sunderland (awarded biennially in recognition of evidence of ability to take a share in the control of industry); R. L. Weighton Medal to Wilfred Bailey, on the result of the Durham final engineering degree examination at King's College, Newcastle-upon-Tyne.

Announcements

THE title of professor of physics applied to medicine in the University of London, with the status and designation of appointed teacher, has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital (Free).

PROF. H. VINCENT, professor of epidemiology in the Collège de France, formerly inspector-general of the Health Service of the French Army, has been elected vice-president of the Paris Academy of Sciences.

DR. H. MARK, formerly professor of physical chemistry in the University of Vienna, has been appointed professor of organic chemistry in the Polytechnic Institute of Brooklyn. He will direct research in the field of high molecular weight compounds.

AT a meeting of the Society of Experimental Psychology recently held at the University of Pennsylvania, the Howard Crosby Warren Medal, which is given annually by the Society for outstanding research in the field of experimental psychology, was awarded to Ernest R. Hilgard of Stanford University, for his analysis of the conditioned response and his demonstration of its integration with the verbal and volitional processes in learning and retention.

BY acquiring the 335,000 Jews of the Baltic States the Soviet Union now has the largest Jewish population in the world, 4,835,000, made up approximately as follows: Russia proper, 3,050,000; Soviet Poland, 1,250,000; Bessarabia, 200,000; Baltic States, 335,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Polarization of Electrons by Double Scattering

THE general theory of the polarization of electrons by double scattering has been given by Mott[1], but detailed calculation of the percentage asymmetry to be expected in the azimuthal distribution after the second scattering at 90° has only been carried out for scattering fields of pure Coulomb type. In view of the fact that experiments have so far revealed no appreciable asymmetry under conditions when an appreciable percentage effect would be expected (for scattering of 79 kv. electrons by gold)[2], it is important that detailed analysis of expected effects for other types of scattering field should be carried out.

We have investigated the polarization effects arising from scattering by the atomic fields of gold, xenon and krypton (that is, screened Coulomb fields) for a wide range of electron energies (100 ev.–150,000 ev.). The differential equations involved have been solved in many cases by exact numerical integration and in other cases by use of Jeffreys' approximation[3], the validity of the latter having been first established. It is found that, in the energy range covered by Mott's calculations for the unscreened field of the gold nucleus, introduction of screening has no important influence, and the failure to obtain the predicted asymmetry remains unexplained.

An interesting effect of the screening is to make possible, in scattering by gold, the existence of large polarization in small energy ranges at low energies (of the order of a few hundred electron volts). Although the precise energy ranges in which these effects occur cannot be determined accurately by the theory, their existence can be demonstrated in the following manner. The percentage asymmetry involves the ratio of an asymmetry factor to a term which is proportional to the intensity of single scattering at 90°. In a screened Coulomb field, unlike an unscreened one, the latter term varies in an irregular manner with electron energy up to energies of some thousands of electron volts. In particular, for certain narrow electron energy ranges, it falls to very low values, as revealed from the experiments of Arnot on electron scattering in mercury vapour[4]. The asymmetry factor, on the other hand, does not vary so markedly. It is determined largely by the phase difference χ_1 at infinity between the wave functions for the $p\frac{1}{2}$ and $p\frac{3}{2}$ electrons. This we find remains, for gold, between 0·24 and 0·34 radians over an energy range of 250 ev.–100,000 ev. It follows, then, that at energies for which the single scattering at 90° is at a minimum value, the percentage asymmetry may be quite large. Owing to its association with low intensity of total scattering, it will be difficult to detect this experimentally, although there are advantages in using the lower energy electrons involved. Calculations reveal that for xenon and krypton the values of χ_1 are insufficient to give appreciable polarization at any energy.

As a further type of scattering field, as far removed from the Coulomb type as possible, we have considered the spherical potential well. This also is found to give rise to polarization effects, which tend to occur in narrower energy regions than for a Coulomb field.

Details of the investigation, together with its bearing on the nature of the modifications of the interaction energy between an electron and an atomic nucleus necessary to reduce the theoretical polarization, will be published in the *Proceedings of the Royal Society* when circumstances permit.

C. B. O. MOHR.
University of Cape Town.
H. S. W. MASSEY.
University College, London.

---

[1] *Proc. Roy. Soc.*, A, 135, 429 (1932).

[2] Dymond, E. G., *Proc. Roy. Soc.*, A, 136, 638 (1932).

[3] Mott and Massey, "Theory of Atomic Collisions" (Clarendon Press, 1933), 90–92.

[4] *Proc. Roy. Soc.*, A, 130, 655 (1931).

Derivation of Einstein Effect from Eclipse Observations of 1936

THE total solar eclipse of June 19, 1936, gave Japanese astronomers an excellent opportunity for solar research. The central line ran just parallel to the north-eastern coast of Hokkaido, facing Okhotsk Sea. More than twenty sites were occupied by Japanese and visiting observing parties. Our party, being the expedition from the Tôhoku Imperial University at Sendai, decided to make observations at Kosimizu, the co-ordinates of which are:

astronomical longitude: 144° 28′ 3″ E.
= 9h. 37m. 52·2s. E.
astronomical latitude: 43° 51′ 21″ N.

Our observing programme was mainly directed towards testing the Einstein effect. For this purpose, a special lens was made by Nippon Kogaku Kogyo K. K. (Japan Optical Industry Company, Limited) with aperture 20 cm. and focal length 500 cm. This lens was used horizontally with one cœlostat mirror.

The plate used was "Oriental 1200", size 25 cm. × 30 cm., thus covering a sky field of 2·9° × 3·4°. Duration of totality was 109 seconds, and during that time only one plate was taken with exposure of 80 seconds. Ten star images were recognized on the plate, but two of them were so near to the edges that they could not be measured.

After the lapse of about half a year, two comparison plates were taken at Sendai, not at Kosimizu. These comparison plates were called No. 115 and No. 119.

The plates were then brought to the Tokyo Astronomical Observatory. By the kindness of the staff of the Observatory, the use of the Zeiss blink microscope was given freely, and with that instrument the relative displacements of the star images on the eclipse plate and on one of the comparison plates were measured very accurately. These measurements were corrected for differential refraction, differential aberration and proper motion, and then reduced by the method of least squares. In doing so, the so-called "Entartung" problem discussed by Dr. Freundlich was not touched, and the usual method of six plate constants and Einstein constant was adopted. The observation equations run as follows :

$$A + Cx + Dy + Fx^2 + Gxy + E\frac{R_\odot}{r}\frac{x}{r} = \Delta x,$$

$$B + Cy - Dx + Fxy + Gy^2 + E\frac{R_\odot}{r}\frac{y}{r} = \Delta y.$$

Here x, y are in the increasing directions of right ascension and declination. By forming the normal equations, the six plate constants A, B, C, D, F, G and Einstein constant E were calculated, with the following results :

$E = 2{\cdot}13''$ .. .. Eclipse Plate—No. 115,
$E = 1{\cdot}28''$ .. .. Eclipse Plate—No. 119.

The details will in due course be published in Vol. 18, No. 1 of the *Japanese Journal of Astronomy and Geophysics*.

T. MATUKUMA.

Astronomical Institute,
Tôhoku Imperial University,
Sendai.
June 20.

Evaporation of Water through Multimolecular Films

Hedestrand[1], Rideal[2] and Langmuir[3] have shown that unimolecular films generally do not reduce evaporation from water surfaces into air to an appreciable extent, the reason being that the evaporation resistance (the reciprocal of the evaporation rate) of unimolecular films is of the same order as the evaporation resistance due to collisions of the evaporating molecules with air molecules and subsequent deflection to the water surface. The only exception is cetyl alcohol, which shows appreciable reduction ; we found that octadecyl alcohol behaves similarly to cetyl alcohol.

F. Sebba and H. V. A. Briscoe[4] have recently shown that unimolecular films may produce substantial reduction when they are compressed. They have also investigated a thick film of lubricating oil showing the first interference colours and found a reduction of only a few per cent. However, with films of much greater thickness they found appreciable reduction.

We have investigated the evaporation through layers of 0·5–5 μ thickness of paraffin oil, which were obtained by the aid of spreading agents. The research was undertaken with a view to practical application in the protection of dams, etc., in the arid areas of the interior of Australia. The laboratory conditions had, therefore, to be similar to natural conditions, and it was for this reason that evaporation in open Petri dishes was investigated. No particular difficulty is experienced in obtaining a film of about 1–2 μ thickness which will reduce evaporation by 50–60 per cent. The most successful films are those obtained from dilute solutions (for example, 1 : 50) of boiled linseed oil, stand oil, terebinth oil, or high boiling fractions of eucalyptus oil in white paraffin oil. On the other hand, simple fatty acids and alcohols, added to paraffin oil, may cause initial spreading, but the films are unstable and collect into lenses after some time. Lubricating oils also do not generally spread well, although they no doubt contain 'amphipathic' molecules as a consequence of oxidation of paraffins.

Particularly high reductions (up to 99 per cent) have been obtained with thin films (0·5–1·0 μ) of certain high boiling fractions of the neutral oil of vertical retort tar. All these observations relate to films on neutral water.

The problem of the stability of these multimolecular films of hydrocarbons, spread by amphipathic molecules adsorbed in the interface, is still obscure. The films deteriorate with time under present experimental conditions. This is probably due to dust settling on the surface. Addition of dust, unless it be purely siliceous, always reduces the effectiveness of the film. There are indications of chemical changes (for example, polymerization) of the spreader, especially in the case of linseed oil and stand oil. However, it is doubtful whether they are responsible to any considerable extent for the deterioration, for no such deterioration is found within two weeks with paraffin – stand oil films investigated in a desiccator, if the film thickness is greater than 1 μ. Thinner films, however, show deterioration even under these conditions. We are at present examining the question of stability more closely and we intend to investigate the thermodynamic conditions directly by determination of the spreading coefficients.

The influence of winds on multimolecular films is interesting. It has been found by experiments in a wind tunnel that the reduction of evaporation in a wind is greater than in still air. This apparently surprising result is, however, readily understandable, since the wind increases the rate of evaporation from the free surface more than from a film-covered surface. In other words, the air resistance is considerably lowered by the wind, whereas the film resistance is but little affected. This holds, of course, only so long as the continuity of the film is not seriously affected by the wind. Under laboratory conditions, the film remained effective even when air was blown directly against the surface by a fan. Under natural conditions, on the other hand, the position is more unfavourable as a consequence of the great areas involved. During experiments on a dam of approximately 300 square yards area, it was found that on windy days the film was blown right into a corner, although it usually spread again after the wind had subsided. The main difficulty with respect to dams is, however, due to the short life period (a few days) of the films under natural conditions, most probably as a consequence of the action of dust and suspended material.

We are greatly indebted to the trustees of the Science and Industry Endowment Fund of the Council for Scientific and Industrial Research of Australia for a research grant.

A. R. DOCKING.
E. HEYMANN.
LUCY F. KERLEY.
K. N. MORTENSEN.

Chemistry Department,
University of Melbourne.
May 31.

---

[1] Hedestrand, G., *J. Phys. Chem.*, **28**, 1244 (1924).

[2] Rideal, E. K., *J. Phys. Chem.*, **29**, 1585 (1929).

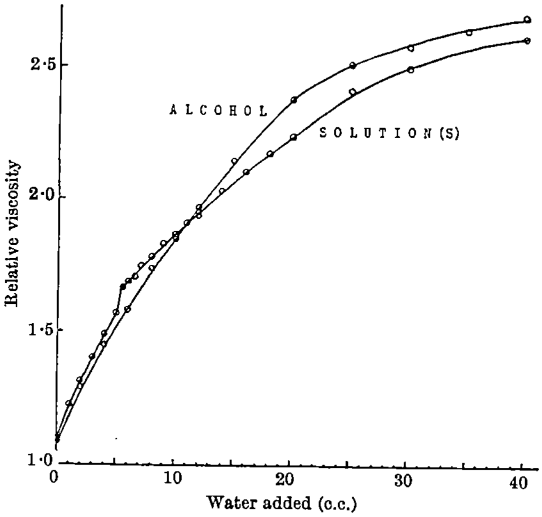
[3] Langmuir, L., and Langmuir, D. B., *J. Phys. Chem.*, **31**, 1719 (1927).

[4] Sebba, F., and Briscoe, H. V. A., *J. Chem Soc.*, 106 (1940).

Binding of Water by Stearanilide

I HAVE suggested[1] that in the hydrated anilides of stearic and palmitic acids, the 'bound' water is held by a micellar structure. Some further evidence supporting this view has now been obtained.

Quantities (0–40 c.c.) of distilled water were added to 50 c.c. samples of a 0·1 per cent solution of stearanilide in absolute alcohol (*S*). The mixtures were well shaken and allowed to stand for 20 hours. Mixtures containing 0–5·0 c.c. water were clear; slight opalescence developed in those containing 5·5–7·0 c.c. water; with more than 7 c.c. added water a white precipitate of hydrated stearanilide was formed. The bulk of precipitate increased gradually with the amount of water but became constant when this reached 15 c.c.; no further precipitation occurred on adding more water to the filtrates from solutions originally containing 15 c.c. or more of water.



Solutions containing a precipitate were filtered through sintered glass and the filtrates collected in dry vessels. The relative viscosities of all the solutions were then measured at 20° C., using a Höppler Viskosimeter. Afterwards the relative viscosities of a series of alcohol-water mixtures (prepared by adding 0–40 c.c. distilled water to 50 c.c. samples of absolute alcohol) were measured under the same conditions. In the accompanying graph are shown the viscosity changes brought about by adding water to 50 c.c. solution *S* and to 50 c.c. absolute alcohol.

Interpretation of these results may be attempted along the following lines: addition of water to solution *S* lowers the solubility of the stearanilide, but before precipitation occurs aggregation of the stearanilide molecules into micelles of colloidal dimensions takes place (this is shown by the development of opalescence and an abrupt increase in viscosity as the amount of added water is increased from 5·0 to 5·5 c.c.). Addition of more water has three effects: (1) hydration of the micelles in solution, (2) precipitation of hydrated stearanilide, (3) dilution of the intermicellar fluid. Factor (2), involving abstraction of water from the intermicellar fluid, tends to decrease viscosity and is operative in solutions containing 7–15 c.c. added water. Factor (3) has the opposite effect (the alcohol-water curve) and operates throughout the series. The influence of factor (1) on viscosity is obscure because two actions are opposed, namely, swelling of the micelles and removal of water from the intermicellar fluid. In the region where factors (1) and (3) only are in operation (that is, with 5·5–7·0 c.c. added water) the slow rise in viscosity suggests that the second action predominates.

The precipitation of hydrated stearanilide is complete when 15 c.c. water have been added to 50 c.c. solution *S*. At this stage the precipitated material contains about 95 per cent water of hydration as it floats in the liquid phase. This 'primary' bound water is difficult to remove by ordinary desiccation[1]. With the addition of water in excess of 15 c.c., further hydration of the precipitate takes place, as is shown by the widening of the gap between the two curves. Easily removed by ordinary drying methods, this 'secondary' bound water is probably held loosely on the outer surfaces of the swollen micelles. The amount of 'secondary' bound water taken up reaches a constant value when the quantity of water added to 50 c.c. solution *S* exceeds 30 c.c. (the attainment of complete hydration of the stearanilide is indicated by the two curves becoming parallel).

B. A. TOMS.

Department of Chemistry,
The Queen's University,
Belfast.
July 15.

---

[1] NATURE, 145, 1019 (1940).

Does the Hypophysis Secrete a Pancreotropic Hormone?

EXPERIMENTS to determine whether the anterior pituitary lobe secretes a 'pancreotropic' hormone, that is, a hormone necessary for the maintenance and function of the pancreatic islets, have been made on the following lines:

(1) The pituitary gland was removed from a series of Wistar rats. The weight of the pancreas decreased, in proportion to the body weight, from an average of 0·57 gm./100 gm. of body-weight to 0·44 gm./100 gm. one month after hypophysectomy. At the same time the insulin extractable from this diminished pancreas was equal to or even greater than that of control animals, in proportion to the body weight[1,2]. Thus, 150 control rats contained 0·64 units of pancreatic insulin per 100 gm. of body-weight, while 77 animals weighing 118 gm. one month after hypophysectomy contained 0·62 u./100 gm., and 48 rats weighing 78 gm. under similar conditions contained 1·06 u./100 gm.

(2) When crude anterior pituitary extracts containing the pancreotropic factor[4] were administered to the hypophysectomized rat by injection, the relation of pancreatic insulin to the increased body-weight remained at or returned to the limits for control animals (0·69 u./100 gm. for thirty-five rats averaging 128 gm. at operation, and 0·58 u./100 gm. for thirty rats averaging 83 gm. at hypophysectomy).

(3) Implantation of tablets of œstrogen depresses growth by interfering with normal pituitary function. Under such conditions the size of the pancreas is not diminished in proportion to body weight and the insulin contained therein is significantly increased in

relation to the weight of the animals, as it tended to be after hypophysectomy (1·12 u./100 gm. in 41 rats 3–4 weeks after the subcutaneous implantation of two 15 mgm. tablets of stilbœstrol, and 1·01 u./100 gm. one month after implantation of one 12 mgm. tablet of œstrone). When rats carrying stilbœstrol tablets further received injections of crude anterior pituitary extract, the insulin increased in approximate proportion to the growing body-weight, remaining higher than in control rats (1·26 u./100 gm. for 42 rats after two weeks daily treatment with extract).

In order to demonstrate that the pituitary gland secretes a pancreotropic hormone it is necessary to show that removal of the gland results in a diminution in size and activity of the pancreatic islets (in proportion to the body weight) and that this condition may be cured or prevented by pituitary therapy. The evidence here presented does not support the assumption that the anterior pituitary lobe exerts a direct hormonic control over the islets of Langerhans, although extracts of this gland contain a pancreotropic substance capable of increasing the amount of islet tissue and of insulin, in the pancreas of the normal rat[3,4].

The results will be given in detail and discussed in a paper to be published by one of us (M. G.) in the *Journal of Endocrinology*. We wish to express our indebtedness to Messrs. Boots and Co. for the gift of stilbœstrol and for the preparation of the tablets.

M. GRIFFITHS.
(Overseas Scholar of the 1851 Commission)

F. G. YOUNG.
National Institute for Medical Research,
Hampstead,
London, N.W.3.

---

[1] Krichesky, B., *Proc. Soc. Exp. Biol.*, N.Y., **34**, 126 (1936).

[2] Haist, R. E., and Best, C. H., *Science*, **91**, 410 (1940).

[3] Richardson, K. C., and Young, F. G., *J. Physiol.*, **91**, 352 (1937).

[4] Marks, H. P., and Young, F. G., *Lancet*, i, 493 (1940).

Nature of Oxidative Phosphorylation in Brain Tissue

A CONNEXION between oxidation of pyruvic acid and esterification of inorganic phosphate with hexosemonophosphate to hexosediphosphate in brain preparations has been recently described[1]. I have now found that glucose can be substituted for hexosemonophosphate and the phosphorylation product is still hexosediphosphate. The necessity of 'adenine nucleotide' for the above reaction as well as the dependence of the oxidation on the presence of both 'adenine nucleotide' and inorganic phosphate[2] led to the assumption that the oxidation of pyruvic acid was linked up to a phosphorylation of adenylic acid to adenosinepolyphosphate, which would then transfer its labile phosphate groups to hexosemonophosphate or glucose. This is supported by the fact that either glucose or hexosemonophosphate can be phosphorylated to hexosediphosphate anærobically by transfer of phosphate from phosphopyruvic acid in the presence, but not in the absence, of adenylic acid. Half of the phosphopyruvate phosphate is set free and the other half is esterified with glucose or hexosemonophosphate. This is the same ratio as was found by Ostern, Guthke and Terszakovec[3] for the transfer of phosphate from adenosinetriphosphate to hexosemonophosphate in muscle extract. The phosphorylation of glucose under these conditions had not been so far observed in animal tissues.

The reactions taking place with glucose can be formulated as follows:

(1) 4 phosphopyruvic acid + 2 adenylic acid = 2 adenosinetriphosphate + 4 pyruvic acid.

(2) 2 adenosinetriphosphate + 1 glucose + 2 H_2O = 1 hexosediphosphate + 2 H_3PO_4 + 2 adenylic acid.

The sum of equations (1) and (2) is the overall reaction (3):

(3) 4 phosphopyruvic acid + 1 glucose + 2 H_2O = 1 hexosediphosphate + 2 H_3PO_4 + 4 pyruvic acid.

Recently Colowick, Welch and Cori[4] concluded that the oxidative phosphorylation of glucose in kidney extracts, previously studied by Kalckar[5], is linked up with the oxidation of succinic to fumaric acid. In brain dispersions oxidation of succinate does give rise to phosphorylation of glucose. However, if oxidation of the pyruvate—arising by subsequent oxidation of malate to oxaloacetate and breakdown of the latter—is checked by arsenite, the ratio atoms phosphorus esterified to molecules oxygen taken up is only about a half of that obtained when pyruvate is oxidized (in the absence of arsenite) as shown in the accompanying table. Arsenite, whilst fully inhibiting both oxidation of pyruvate and the accompanying phosphorylation, is without effect on the phosphorylation of glucose by transfer of phosphate from phosphopyruvic acid.

1·5 ml. dispersion from pigeon brain (dialysed 6·5 hours) to 2·3 ml. with additions including phosphate buffer *p*H 7·3 (0·025*M*), Mg^{++} (0·2 mgm.), adenylic acid (0·0007 *M*), glucose (10 mgm.), and NaF (0·02*M*). 35 min. in air at 38°. (O_2 uptake measured during the last 30 min.).

	No further addition	Na fumarate (0·005*M*) +Na pyruvate (0·013*M*)		Na succinate (0·03*M*)	
		No arsenite	0·008*M* Na arsenite	No arsenite	0·008*M* Na arsenite
µl O_2 uptake	0	320	19	276	178
mgm. P esterified	—	1·20	0·00	0·77	0·23
atoms P/mols O_2	—	2·78	0·00	2·01	0·94

The above suggests that the oxidative phosphorylation may be of a twofold nature; half of it being connected with the dehydrogenation of pyruvic acid as suggested previously[1], the other half with the transfer of hydrogen catalysed by dicarboxylic acids. This view would seem to be supported by the fact that when pyruvate is oxidized by brain dispersions, in the presence of fumarate, the P/O_2 ratio in the first few minutes is 4 atoms phosphorus to 1 molecule oxygen. It would be difficult to understand how the removal of 2H would give rise to an uptake higher than 1 atom phosphorus unless their further catalytic transfer is also linked up with phosphorylation.

I am indebted to Prof. R. A. Peters for his interest and to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

S. OCHOA.
Department of Biochemistry,
Oxford.

August 5.

---

[1] Ochoa, NATURE, **145**, 747 (1940).

[2] Banga, Ochoa and Peters, *Biochem. J.*, **33**, 1980 (1939).

[3] *Z. physiol. Chem.*, **243**, 9 (1936).

[4] *J. Biol. Chem.*, **133**, 359 and 641 (1940).

[5] *Biochem. J.*, **33**, 631 (1939).

Distribution of Ammonia in Larvæ of *Lucilia cuprina*

It has been established that sterile larvæ of *Lucilia sericata* excrete the bulk of their nitrogen in the form of ammonia[1,2]. Similar studies with larvæ of the Australian sheep blowfly, *L. cuprina*, support these findings. When reared on a medium composed of yeast, egg white and sodium chloride[3] the ammonia excretion per 100 larvæ increased after hatching until the larvæ were fully grown and then it diminished rapidly as they approached the pupal state.

This work has been extended to a microchemical study of the distribution of ammonia in the organs and tissues of larvæ of *L. cuprina*. For qualitative testing, mature larvæ were opened under isotonic saline (1·5 per cent sodium chloride). The saline was then removed and the reagent applied. Nessler's reagent and Riegler's reagent were each employed. The latter was prepared according to the directions of Feigl[4], saturated calcium hydroxide being used to render the solution alkaline.

For the quantitative study, the larvæ were reared on the artificial egg white – yeast medium containing 0·01 per cent brom cresol purple. As shown by Waterhouse[5], this indicator serves to define the acid mid-segment of the midgut. For each experiment, 10 larvæ were subdivided into the required portions. The dissections were performed under isotonic borax (2·5 per cent $Na_2B_4O_7$) to prevent the formation of ammonia during treatment and ammonia was estimated by adapting the permutit-Nessler method[6] to deal with micro quantities.

As shown in the accompanying table, the results obtained by the three methods agree fairly well.

Method	Fat body	Integument & skeletal muscle	Midgut			Hindgut		Malpighian tubes
			Anterior	Mid	Posterior	Anterior half	Posterior half	
Qualitative								
Nessler's Reagent	+	+	–	++	–	++	++++	+
Riegler's Reagent	+	+	–	++	–	+++	+++	+++
Quantitative mgm. per cent NH_3-N (Av. of 9 experiments)	21	3	11	27	4	206	544	77

These data help to elucidate the mechanism of ammonia formation and excretion in this organism. They are interpreted as showing that ammonia, produced in the midgut, is absorbed into the hæmocœle and transferred to the Malpighian tubes. The dilute ammonia solution, transmitted from the Malpighian tubes to the hindgut, is gradually concentrated by re-absorption of water as it moves along the hindgut towards the anus. This view of the mechanism of ammonia excretion, which implies that ammonia passes into the body cavity, is also supported by analyses of the hæmolymph, which contains 12 mgm. per cent NH_3-N. Acidity in the mid midgut would explain the high ammonia capacity of the gut contents in that region. Ammonia is occasionally detected in the crop if the diet has become rich in excreted ammonia.

Except in the alimentary canal and the Malpighian tubes, the ammonia concentration is relatively low. Some storage of ammonia occurs in a few cells of the fat body, and a portion resides in the integument, sometimes becoming visible as a thin brown line just beneath the cuticle when Nessler's reagent is applied.

A fuller discussion of this work will be published in Australia by the Council for Scientific and Industrial Research.[7]

F. G. Lennox.
Division of Economic Entomology,
Council for Scientific and Industrial Research,
Canberra.
May 21.

[1] Michelbacker, A. E., Hoskins, W. M., and Herms, W. B., *J. Exp. Zool.*, 64, 109 (1932).

[2] Brown, A. W. A., *Biochem. J.*, 32, 903 (1938).

[3] Lennox, F. G., Coun. Sci. Ind. Res. (Aust.). Pamphlet No. 90 (1939).

[4] Feigl, F., translated by J. W. Mathews, "Qualitative Analysis by Spot Tests" (Amsterdam: Nordemann Pub. Co., 1937).

[5] Waterhouse, D. F., Coun. Sci. Ind. Res. (Aust.), Pamphlet in press.

[6] Peters, J. P., and Van Slyke, D. D., "Quantitative Clinical Chemistry", Vol. 2. (Baltimore: The Williams and Wilkins Co., 1932.)

[7] Lennox, F. G. A contribution to the series "Studies of the Physiology and Toxicology of Blowflies".

Practical Science in Schools

I feel from my own teaching experience that practical work by pupils is essential in order to avoid that common type of 'learning' in which the pupil obtains credit for knowing work, and himself believes he knows it, merely because he is adept at quoting phrases of which he has not properly understood the meaning[1]. Recently the Spens Report has stressed the educational importance of 'activity' (that is, *use* of the pupil's knowledge and abilities), and of handwork. These imply that knowledge, if it is to last, must be tested and corrected by being put to practical use, and so converted into a habit; and that, in learning, the hand has an important part to play as an organ of sensation.

Would curtailment of practical work necessarily promote the consideration of social and humanistic contacts? I fear it would unconsciously encourage a dogmatic and authoritarian attitude, by removing that constant reference to observed fact which is the distinguishing mark of science. Since this experimental attitude permeates both the theoretical outlook of science and its technical use, it is an essential part of all its social values too.

If a science teacher asks himself, at each stage in his teaching, what aims he has in view, and applies an experimental outlook to the problem of how to achieve them, he will find that some traditional practical work can be omitted. But at the same time by watching how children react if allowed to do as they please with, for example, lenses, magnets, earthworms, mechanics apparatus (provided this is large enough for the forces to be felt by the organs with which we normally estimate forces—the sensory nerves of the muscles), he will find many suggestions for pupils' practical investigations bearing on everyday life, scientific method, applications of biology, local industry, etc.

With elementary classes one can often reduce expenditure by using robust commercial apparatus instead of fragile laboratory ware, commerical chemicals when pure ones are not needed, and the products of ordinary shops and of Nature whenever possible. This at the same time brings closer the social and humanistic contacts required.

E. T. Harris.
"Hazelwood",
Ivy Road,
Bolton, Lancs.
Aug. 8.

[1] See also Nature, June 1, p. 863, June 29, p. 1023 and July 27 p. 133.

RESEARCH ITEMS

Stone Implements from Canberra, Australia

The Canberra meeting of the Australian and New Zealand Association for the Advancement of Science was made the occasion by H. P. Moss of an exhibition and survey of aboriginal Stone Age material found in the Capital Territory (Report, 24th meeting, 1939). More than three hundred specimens were exhibited; with two exceptions, all were collected from the area constituting the City of Canberra, the author's first discovery being an axe-head found close to the Acton offices in 1919. At first sight the specimens, especially the scrapers and points, appear to suggest that there were two waves of Stone Age culture; the difference is to be explained by the fact that while much material was collected on ridges exposed to the winds as well as alternations of heat and cold, a considerable amount was recovered from depths ranging from two or three to six feet below the surface and had thus been protected against weathering. The depth of a find affords little criterion of age, as for example, in Crete, where twelve inches is estimated as the equivalent of a hundred years. In Canberra, high winds blowing continuously for a number of hours will cause a remarkable accumulation of sand deposit or an equally remarkable denudation. In regard to future investigation, at least five localities are indicated as worth examination in view of their suitability for aboriginal camps as regards both food supply (small game) and shelter from the prevailing wind.

Vaghers of Okhamandal

S. T. Moses, while acting as director of fisheries, Baroda State, was brought into intimate contact with the historic and interesting community of the Vaghers, for whose relief a pearl fishery was organized recently. Observations were made and anthropometric measurements taken (*J. Roy. Asiat. Soc. Bengal, Letters*, 5; 1939). They are undoubtedly among the earliest inhabitants of the Okhamandal district and are descended from the aboriginal inhabitants, the Kalas, one of the three tribes said to have sprung from the sweat of God. There has been great admixture, especially with races of Rajput origin. The first conqueror of the district was the king of the Yadavas, who was the eighth incarnation of Vishnu. The original occupation of the Vaghers was fishing, but they developed into a violent freebooting tribe, though authority has now persuaded them to take to agriculture, and many follow fishing, pearl-fishing and sailing as an additional occupation. Their speech is a jumble of Gujarati and Cutchi, a mongrel speech intelligible only after long residence. The men give a military salute instead of the more general salaam, while the women greet their relatives by cracking their fingers on the temples or on the head-scarf just above. In religion they are Hindus but, as is usual with many other Hindus, they go to the shrines of Muhammadan saints for the cure of diseases. Marriage, usually arranged by the parents, is preceded by a betrothal. The marriageable age is 15–20. The ceremonies differ in no way from those of surrounding castes, Brahmin priests officiating. Men seldom marry more than one wife and divorce is easy. The men are of medium stature, the range of variation being from 5 ft. 1 in. to 5 ft. 10 in., the cephalic index varying from 76·9 to 86·4.

Changes in the Colours of Birds

In order to define more accurately the changes in the colour of plumage due to the wearing and the fading of feathers, Frederick H. Test has studied the plumage of flickers (Colaptes) (*Condor*, **42**, 76; 1940). Exposure of several kinds of fresh feathers to sunlight for sixty-five days produced distinct fading. The carotenoid colours (reds and yellows) of all feathers except the red malars and nuchal crescent feathers were strongly affected; the latter type of red was apparently unaltered. The changes in colour probably result from slow oxidation under the influence of sunlight. The melanic hues (browns, blacks and greys) were only slightly affected by the exposure. These experimental changes correspond with the conditions found in breeding birds, the amount of change varying with the degree of exposure to sunlight. The changes seen in the melanic colours are principally due to a loss of pigment through abrasion. Black regions scarcely change, because loss of pigment is slight and such loss as occurs is imperceptible on account of the great concentration of black.

Induced Evolution through Chromosome Changes

A. F. Blakeslee, director of the Department of Genetics, Carnegie Institution of Washington, read a paper on induced evolution in plants through chromosome changes before the Eighth American Scientific Congress. Evolution of plant types is dependent upon changes in their chromosomes. In addition to changes in individual genes, gross changes in chromosome structure may be induced by X-rays, radium, heat and ageing seeds. Chromosomes may be broken and their parts interchanged (segmental interchange) or a part may be attached to the end of another chromosome (simple translocation). By treatment with heat or a number of different chemicals, notably colchicine, it is possible to induce the chromosomes to double in number. We now have the three following ways of making new species by laboratory methods: (1) Combining interchanged chromosomes in such a way that to the end of a chromosome there is added extra chromosomal material which brings about changes in the structure and appearance of the plant. This method is not yet known in Nature. (2) Interpolation of the extra material inside another chromosome. This method is suspected in Nature. (3) Doubling chromosome number in sterile species hybrids to produce new pure-breeding types with enhanced vigour. This method is known to have occurred in Nature both in the formation of wild species and in the production of superior varieties of cultivated plants.

Salivary Gland Chromosomes

A step towards the elucidation of chromosome structure has resulted from the treatment of salivary gland chromosomes by solutions varying in pH of 1–14. M. Calvin, M. Kodani, and R. Goldschmidt (*Proc. Nat. Acad. Sci.*, **26**, 340–349: 1940) find that at the highest range ($p\text{H} = 13$) several changes take place. Initially the chromosomes lose their striations of disks, but retain a clear outline. The chromosomes then show two beaded strings with lamp-brush connexions between the beads. Afterwards, the two strings (chromatids) synapse and then condense.

Finally, the chromosomes lose the lamp-brush structure and may become invisible. The rate of these changes varies with the pH and the later stages may not occur in lower pH ranges. It is suggested that the phenomena are in keeping with the behaviour of a partially folded and partially extended polypeptid chain. The secondary bands are broken by the high pH which corresponds with the iso-electrical part of nucleoprotein. The double chromonema constituting one chromatid only becomes visible when the treatment by alkali concentrates the nucleic acid upon them. Other chromonemata are fully expanded to form the loops and bristles of the lamp-brush appearance. They have been named trophochromatin and are believed to provide reserve material for growth.

Cytogenetics of Maize

THE third chromosome of maize consists of two arms, the long arm being twice as long as the short arm. E. G. Anderson and R. A. Brink (*Genetics*, 25, 299–309; 1940) have summarized their analysis of the genes and translocations of chromosome 3. The order of the genes on this chromosome is cr, d_1, Rg, ts_4, la, na, a; the linkage group consist of 103 units, while cr is positioned towards the short arm. About twenty translocations were found to be distributed from the position of d_1, on the short arm, almost to a, in the distal part of the long arm. The relations of the genes with the translocation and the cytological position of the translocations breaks on the chromosome were determined.

Early Mammals of South America

THE early Tertiary mammals of South America, found in a sequence of five formations between the latest Cretaceous and the latest Oligocene in central Patagonia, were discussed by G. G. Simpson in a contribution to the Eighth American Scientific Congress (May 1940). The earliest faunas contain marsupials, more varied than otherwise known outside Australia, armadillos, ground-sloths and highly varied, archaic, hoofed mammals. During the Oligocene, rodents allied to the tree-porcupines, cavies and chinchillas appeared. The author considers that the hypothesis that these faunas were of Australian origin is poorly supported. He thinks that the peculiarity of the assemblage that occupied South America raises a question that still defies any reasonable answer. W. B. Scott carries on the astonishing story of mammalian evolution from the Miocene to the Pleistocene. The Miocene Santa Cruz beds are mainly stratified ash in which the skeletons of mammals and birds are preserved with exceptional completeness. The fauna is very rich and varied, but is made up almost entirely of groups that are not known in any other part of the world, such as predaceous marsupials, peculiar hoofed animals, the bizarre astrapotheres, ground-sloths, armadillos, and rodents of the porcupine group. In the Pliocene appears the first mammal, a raccoon-like carnivore, of definitely North American origin. The mammals are much larger than their Santa Cruz ancestors, though smaller than their Pampean descendants. Most impressive is the huge marsupial Thylacosmilus, which imitates the sabre-tooth cats in a remarkable way. The Pleistocene fauna of the Argentine Pampean contains a large immigrant element together with a larger one of native origin. The post-Pleistocene extinctions removed the greater part of this assemblage, which included huge sabre-tooth cats, short-faced bears, giant raccoons and chinchillas, exceptionally large hoofed animals and an astonishing variety of edentates which ranged in size from an elephant to a tapir, and included a glyptodont which attained a length of 15 ft. or more.

Earthquakes of South and Central America

B. Gutenberg and C. F. Richter contributed to the Eighth American Scientific Congress, held in May 1940, a paper on the seismic zones of Central and South America. These zones are part of the circum-Pacific belt of activity, which includes a large majority of the shallow shocks of the world, a still larger proportion of those from intermediate depths (60–300 km.), and practically all those from great depths (300–700 km.). Of the branches from the main belt, one diverges in the region of Oaxaca and passes southward by way of the Galapagos Islands and along the Easter Island Rise; the area between the latter and South America is one of principally continental structure. Two other branches follow loops enclosing outlying areas of Pacific structure, one surrounding the Caribbean Sea and the other following the 'Southern Antilles' of Suess. For shallow shocks, the west coast of Mexico is among the most active regions of the world, with frequent great shocks. The activity of Central America is lower, decreasing to a very minor level in eastern Panama. That of the West Indies has often been over-estimated; it is only moderate. In South America, shocks at shallow depth are relatively infrequent, and occur chiefly close to the coast, except in the Mendoza region and in Peru. The high activity of the Andean zone is due mainly to shocks from intermediate depths, with epicentres usually distant from the coast. The great Chilean earthquake of January 1939 had a focal depth of about 70 km. A belt of intermediate shocks crosses central Mexico from west to east and another passes southward through Central America. Shocks from depths greater than 600 km. occur in a few areas far inland in South America. In another paper, presented by N. H. Heck, it is pointed out that of the 95 seismological stations of the Americas, 66 are north of Mexico, 16 are from there to Panama, and only 13 are situated in South America.

Seismicity of the Northern Pacific Coast of U.S.A.

A CRITICAL survey of the earthquakes of the north-west United States has just been made by Perry Byerly (*Bull. Geol. Soc. Amer.*, 51, 255–260; Feb. 1, 1940). The earthquakes concerned had an intensity at the epicentre equivalent to that required to crack walls and cause chimneys to fall. Some of the facts noted by Byerly are that the most seismic regions in the area are the one about San Francisco Bay and the one just off the coast of Humboldt County. These lie in the more persistent fault zones of the coast ranges and their seaward extensions. It is noteworthy that epicentres practically cease at 42° N. and begin again off the coast of Canada. It is suggested that the San Andreas fault zone reaches the border of the continental mass near 42° N., 126° W., and that the stresses leading to earthquakes, which are common on the continent, do not persist in the ocean floor. Another zone of epicentres along the Sierra roughly parallels that just discussed. The only epicentre at sea off the Oregon coast lies roughly on an extension of this zone. The seismic quiet of

Oregon and Washington is marked. The few shocks about Puget Sound were just large enough to come within the classification stated, but were not large shocks. It is noted that it was in Marin County that the greatest fault displacement was observed in 1906. It appears that in this region and possibly in the region of the centre of the Fort Tajon earthquake (1857) farther south there is greater effective friction along the San Andreas Fault which prevents many small shocks and saves the accumulating strain for larger displacements. Perhaps we have here regions of greater pressure transverse to the fault.

Origin of Microseisms

A VERY thorough and important experimental investigation of the nature and origin of microseisms has been carried out at St. Louis, Missouri, by J. Emilio Ramirez (*Bull. Seis. Soc. Amer.*, **30**, Nos. 1 and 2, January and April 1940). The investigation was carried out during July–December 1938, and specially designed electromagnetic seismographs situated at St. Louis University, Washington University and Maryville College had the same timing arrangements by the same clock, being linked together by telephone wires. The results demonstrated beyond doubt that microseismic waves are travelling, and not stationary, waves, the speed of travel being $2\cdot67 \pm 0\cdot03$ km./sec. During the period mentioned, 80 per cent of the waves came from the north-east, none being recorded from south, west or south-west. The period of the waves was from 3·5 to 7·5 sec. and the wave-length was of the order of 14½ km. The waves were found to have many of the characteristics of Rayleigh waves and over a period of more than a year the recordings of microseisms and microbarometric oscillations (recorded by specially designed microbarographs) showed no direct relationship in wave form, group form, period or duration of storms. The source of the microseisms was over the sea, the amplitude of the microseisms depending only on the intensity and widespread character of the deep barometric lows travelling over the ocean. The period of the microseisms appeared to be a function of the distance between the station and the source of microseisms, though no indication of the mechanism by which microseismic storms were caused was obtained, and large microseisms were evident at times when there was no surf near the coasts or winds blowing from land to ocean.

Accretion and Stellar Energy

R. D'E. ATKINSON has attempted to determine the maximum possible rate of accretion of diffuse matter by stars (*Mon. Not. Roy. Astro. Soc.*, **100**, 7; May 1940). Assuming that a product-formula of the type $A = k.a^xb^yc^z$ . . . . is applicable to all stars, the factors which may reasonably be considered are the star's mass, radius, speed through the diffuse matter, density of the diffuse matter, and the constant of gravitation. If, as is possible, it is necessary to consider temperature or the molecular weight of the diffuse matter, the method of investigation pursued in the paper breaks down. Even the five factors referred to constitute a formidable problem, but a safe assumption can be made regarding the density—that it is involved to the power + 1 only. It is found, however, that the problem of the radiation of bright stars cannot be solved by any admissible accretion formula. It seems impossible to find a formula which will give a high enough rate of accretion to account for the energy of the bright stars, using values of the parameters that are permissible. In addition, the rate of accretion cannot even be high enough to produce the dynamical effects considered by Hoyle and Lyttleton, except in the case of very slow moving stars. Even then, it is necessary to extend the time-scale to 10^{10} years or more, and this involves reducing very much the upper limit to the luminosity that can be accounted for by the transmutation of hydrogen, even with the help of accretion. It is possible that the rate of accretion is not given by any simple product-formula. If it is, then some additional factor is relevant, such as the molecular nature or molecular state of the diffuse gas. Finally, it is suggested that the total radiation of the bright stars requires an additional source of energy beyond that provided by the hydrogen they initially possessed and all that they can afterwards collect.

Ionic Character and Dipole Moment

PAULING has regarded the hydrogen halides in the normal states as superpositions of ionic and covalent states, and the fraction of ionic character as given by μ/er, where μ is dipole moment, r is internuclear separation. F. T. Wall (*J. Amer. Chem. Soc.*, **62**, 800; 1940) has developed the theory and shown that the sum of the dipole moments of two states resulting from resonance is the same as the sum of the dipole moments of the original states. By assuming a wave function $\psi = \psi_c + a\psi_i$ for a system resonating between covalent and ionic states, where ψ_c and ψ_i are the purely covalent and ionic functions and a is a parameter, values of $|a|$ are calculated both from dipole moments and from energy values and the two sets of values are found to be in approximate agreement.

Seasonal Variation in the Height of Meteors

R. A. MCINTOSH has examined (*Mon. Not. Roy. Astro. Soc.*, **100**, 7; May 1940) all available published real paths of meteors in an attempt to confirm the seasonal variation found by Öpik. The paper gives a very exhaustive analysis of the matter at McIntosh's disposal, but it is impossible to deal with the various refinements introduced to secure a high degree of accuracy in the results. Some of his conclusions differ considerably from those of Öpik, who used the data provided by the Harvard Observatory Meteor Expedition (*Tercentenary Papers, Harvard Observatory*, **105**, 549; 1937). Öpik found that there was a slightly greater range of heights in shower meteors, that is, meteors associated with the well-established showers on certain dates, some being connected with comets, than with sporadic meteors, but this was not confirmed by McIntosh. There is a decided seasonal variation in the case of sporadic meteors for the three points examined, appearance, mid-point, and disappearance, and the amplitude of the variation is greatest in the lower levels of the atmosphere, maxima and minima occurring earlier than in higher levels. It is obvious from these facts that the cause of the variation lies in the atmosphere. There is a similarly well-marked seasonal variation in the width of the meteor zone. McIntosh points out that Öpik's use of the harmonic mean heights has certain weaknesses and that it is more correct to use the arithmetic means. The author speaks highly of the accuracy of the work of British observers, and in particular of that of the members of the Meteor Section of the British Astronomical Association.

INCREASE IN ULTRA-VIOLET ABSORPTION OF CYTOPLASM AFTER THERAPEUTIC X- AND GAMMA-IRRADIATION

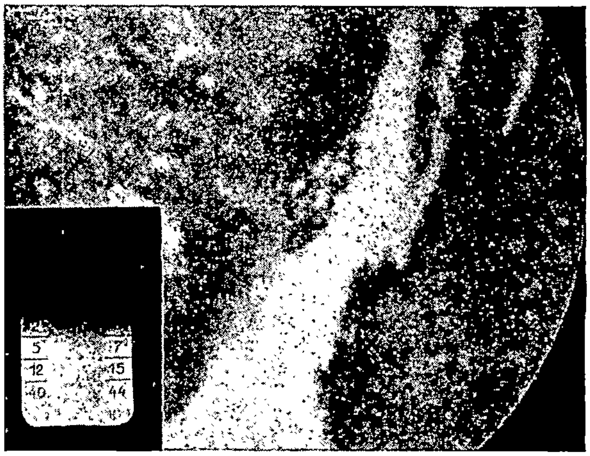
By DR. JOSEPH S. MITCHELL,
DEPARTMENT OF MEDICINE, UNIVERSITY OF CAMBRIDGE

A RELATIONSHIP between the radiosensitivity of tissues and the metabolism of nucleic acid has often been suggested and receives support from certain work, including the possible correlation between the maximum of cellular radio-sensitivity in the premitotic phase[1,2] and the rapid increase in the nucleic acid content of nuclei preceding mitosis[3,4,5].

The aim of the present investigation is to examine the changes in the nucleic acid content, distribution and metabolism resulting from the therapeutic X- and gamma-irradiation of malignant tumours. A technique of ultra-violet microphotography has been developed quantitatively, on the basis of the methods described by Caspersson[3], and applied to biopsy specimens taken from cases during treatment.

The experimental method employs microphotography with light of the wave-length 2537 A., which was selected because of its proximity to the maximum value (2525 ± 10 A.) of the ratio of the absorption coefficients of nucleic acid and of typical proteins in solution. The required monochromatism is attained by employing a mercury-neon discharge tube as light source in conjunction with a chlorine-bromine filter and a photographic plate of correct sensitivity, and has been checked spectrophotographically. The quartz optical system is of the usual type (*cf.* [6,7]) employing a dry objective (6 mm. N.A. 0·70). Sections of control and irradiated tumour are photographed on the same field. From objective measurements of the blackening of the photographic plates under standard conditions, employing a neutral wedge for visible light and radial-sector diaphragms for ultra-violet light, the effective concentration at each point in the sections of nucleic acid or other known absorbing compound can be deduced. For this purpose, a microphotometer of non-recording type has been constructed and also in some cases curves have been obtained by means of a recording microphotometer. An interferometric method has also been developed to measure the small difference in thickness of the sections of control and irradiated tissue.

Measurements have been made on 12 specimens: these comprise 4 squamous cell carcinomata of the lip, 2 squamous cell carcinomata of the fauces, 4 carcinomata of the skin (1 squamous cell, 2 basal cell and one anaplastic carcinoma), 1 squamous cell carcinoma of the cervix uteri, and normal tadpole skin. In all instances the biopsies were taken before and 80 minutes after the end of irradiation; this time was selected to allow the cells caught in division at the time of exposure to complete mitosis. Three cases were treated with X-radiation (effective wave-length ·145 X.U.), 8 with gamma-radiation from radium (applicators) and one with gamma-radiation from radon; the doses used varied from 248 to 4410 r. and the mean dosage rates from 0·317 to 29·7 r./min.



CONTROL IRRADIATED

Fig. 1.

ULTRA-VIOLET MICROPHOTOGRAPHS SHOWING SECTIONS OF CONTROL AND IRRADIATED TUMOUR (CARCINOMA OF THE LIP) ON THE SAME FIELD, TOGETHER WITH A STANDARD NEUTRAL WEDGE (× APPROX. 330).

Control: specimen taken before irradiation.
Irradiated: specimen taken 80 min. after 248 r. in 4·45 hr.

(Treatment with double radium applicator.)

The most striking effect observed was a significant increase in the ultra-violet absorption of the cytoplasm after the X- and gamma-irradiation *in vivo*. This change has been detected after small doses of radiation such as 248, and 388 r. (see Figs. 1 and 2); but it appears probable that the mean dosage rate is a very significant factor in its production. Of the six specimens examined in which the dosage-rates were relatively high (0·91–29·7 r./min.) all gave an increase in cytoplasmic absorption. At low dosage rates (0·32 and 0·53 r./min.) two cases showed no increased absorption while of the 4 cases at intermediate dosage rates (0·53–0·91 r./min.) the two basal cell carcinomata gave a positive effect while the squamous cell carcinomata showed no change.

The increase in cytoplasmic absorption produced by irradiation is of interest in relation to the cytoplasmic absorption recently described[5,8,9] in growing tissues and attributed to pentose nucleotides. The absorbing material appearing after irradiation is not thymonucleic acid itself, as shown by the negative Feulgen reaction, but, at the wave-length 2537 A., corresponds in absorption to that of, for example, a 2 per cent solution of nucleic acid, as in Fig. 1. Thus the magnitude of the observed effect is certainly consistent with the possibility that the increased absorption may be due to purine and pyrimidine

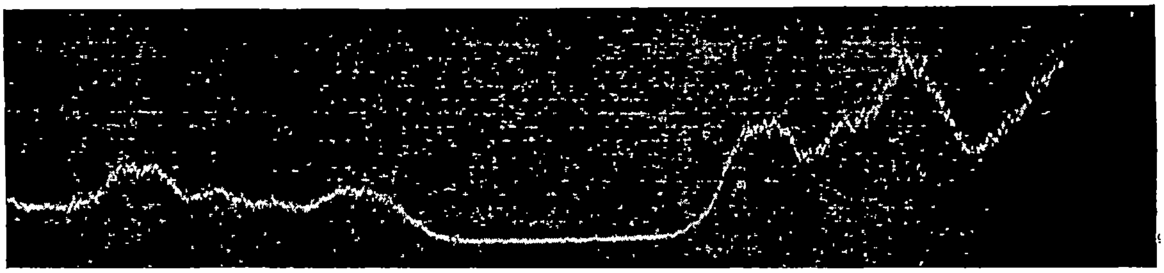


Fig. 2.

MICROPHOTOMETER RECORD OF ANOTHER CASE (CARCINOMA OF THE LIP).
Sections: Control and 80 min. after 388 r. in 6·42 hr.

derivatives. Further, microchemical tests have shown that the increased absorption is accompanied, at least in some cases, by positive pentose reactions in the cytoplasm. This work is in progress and it has been found that the absorbing material can be removed from the cytoplasm in the fixed sections by acid hydrolysis followed by alcohol extraction. Also, *in vitro* experiments have shown that it is unlikely that the observed effect could be due to direct 'photochemical' changes produced in the cytoplasmic proteins by the radiations. At present, little can be said concerning the mechanism of accumulation of the absorbing substances in the cytoplasm as a result of irradiation or of the processes by which they are removed.

On the clinical side, 10 of the cases were treated by myself, and among these there has been no obvious correlation between the response to treatment and the absorption changes described.

I wish to express my grateful acknowledgment to the Medical Research Council and the British Empire Cancer Campaign for financial assistance.

[1] Spear, F. G., *Brit. J. Radiol.*, **8**, 68, 280 (1935).
[2] Spear, F. G., and Glückmann, A., *ibid.*, **11**, 533 (1938).
[3] Caspersson, T., *Skand. Arch. Physiol.*, Suppl. 8 (1936).
[4] Caspersson, T., *Arch. exp. Zellforsch.*, **19**. 216 (1937).
[5] Caspersson T., *ibid.* **22**, 655 (1938).
[6] Köhler, A., and v. Rohr, M., *Z. Instrumentenk.*, **24** (1904) (*cf. J. Roy. Micro. Soc.*, **25**, 513 (1905)).
[7] Barnard J. E., and Welch, F. V., *J. Roy. Micro. Soc.*, **56**, 365 (1936).
[8] Caspersson, T., and Schultz, J., NATURE, **142**, 294 (1938).
[9] Caspersson, T., and Schultz, J., *ibid.*, **143**, 602 (1939).

GEOMAGNETIC RESEARCH IN THE AMERICAS*

BY DR. J. A. FLEMING,
DEPARTMENT OF TERRESTRIAL MAGNETISM, CARNEGIE INSTITUTION OF WASHINGTON

THE earth is a great laboratory in which Nature is constantly performing physical experiments. The student of earth physics labours under the disadvantage that systematic and trustworthy data are available for little more than a century. This period is too limited from which to draw many significant conclusions regarding the complex world-wide and cosmical causes and interrelations involved. In the collection of geophysical data, chief attention must be given to geographical and space-distribution and to variability with time characterizing the phenomena concerned. These data must include not only isolated observations on land and sea but also continuous observations at fixed observatories to follow simultaneous variations with time and co-ordination with experiment in the physical laboratories and astrophysical observatories.

The Americas, with their vast areas, their great river-systems, their mountain ranges rising to elevations second only to the Himalayas, and their surrounding Atlantic, Pacific, and Southern Oceans, offer fertile fields for geophysical investigations. Their natural resources are being made available for human use in large degree by the practical applications of geophysics. The magnetic and electric fields of the earth may be considered more in detail as an outstanding example of the opportunities offered such research in the western hemisphere.

Although a few crude determinations of magnetic direction had been made in the Americas toward the end of the seventeenth century, it was not until the historic oceanic magnetic survey during 1698-1700, sponsored by Edmund Halley, that reliable data in the western hemisphere began to be obtained, and then only for the direction of the compass. The magnetic equator—a line connecting all points where a magnetic force is horizontal—crosses Peru and Brazil. One of the agonics—the line along which the compass points true north—passes somewhat west of north from Montevideo through Brazil, western Venezuela, Cuba, and the United States of America. The delineation of the magnetic equator early aroused scientific interest. In 1802, Alexander von Humboldt located it in the Andes near lat. 7° S.

The Governments of the Argentine, Brazil, and the United States of America have been most active in their magnetic surveys. With the formation of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in 1904 and the inauguration of its world magnetic survey of land and sea in 1905, thanks to the cordial co-operation received from all the American Governments, it was possible for that Department to add many stations to supplement the data already obtained. The distribution of stations of the Carnegie Institution of Washington is densest in those countries not actually executing magnetic surveys. At various times, comparisons of standards with those of other countries have been obtained, and the establishment of absolute magnetic standards of reference has been greatly improved.

---

*Abstract of a paper presented to Section VI (Physical and Chemical Sciences) of the Eighth American Scientific Congress.

Of the 6,000 stations occupied during some two hundred expeditions on land (1904–40) and upward of 4,000 at sea on the *Galilee* (1905–8) and the *Carnegie* (1909–29), at least one third are in the western hemisphere.

The data obtained permit reliable discussions of the distribution of the earth's magnetism and of mysterious variations of its elements from year to year, the so-called magnetic secular variation. These ever-changing lines of magnetic direction and force of the earth, like scientific research, take no account of national boundaries.

Naturally, because of the later opening of new territory in the western hemisphere, Europe at the present time has a great majority of the permanent magnetic observatories. The Americas, however, at the end of the past and during the present century, have established some fifteen permanent observatories well distributed. It would be desirable to have additional observatories at Belem in Brazil and near the southern end of the continent.

Geomagnetic time-changes thus form a main source of information about the physics of the outer layers of the atmosphere, which are subject to distinct cosmical influences on the earth and shield the earth's surface from direct effects. Studies of these outer layers of the atmosphere—the ionosphere—by radio methods supplement magnetic data. Wireless wave-propagation is influenced by the earth's magnetic field, and the location of Huancayo, where the magnetic force is so nearly horizontal, is well suited for experiments on this phenomenon.

The long history of amity and cordial relations between the nations of the western hemisphere supplies a solid foundation upon which in South and North America efforts may be built and co-ordinated for the advancement of earth physics.

PHYSIOLOGY OF PYRIMIDINES*

BY DR. L. R. CERECEDO,
FORDHAM UNIVERSITY

THREE pyrimidines have been found to occur in Nature as constituents of the nucleoproteins, the chief protein material of the cell nucleus. These pyrimidines are: uracil, thymine and cytosine. Recent investigations on the chemical structure of two vitamins, namely, vitamin B_1 and riboflavin, have shown that in these substances we are also dealing with pyrimidine derivatives. In spite of the widespread occurrence of the three pyrimidines present in the nucleic acid molecule, very little is known regarding the function of these substances in the animal economy.

The metabolism of uracil, thymine and cytosine has been studied by several investigators, and it has been found that they are catabolized with the conversion of the nitrogen into urea. The intermediate steps in this conversion, however, remained unknown until they were clarified by studies conducted in our laboratory. As a result of these studies, the following scheme for the intermediary metabolism of uracil was suggested: uracil → isobarbituric acid → isodialuric acid → formyloxaluric acid → oxaluric acid → urea + oxalic acid.

The mechanism suggested by us for the catabolism of uracil has been questioned by Krebs, who studied the action of kidney and liver tissue on uracil, thymine and cytosine. On the basis of his experiments, the details of which have not been reported, Krebs concluded that the pyrimidines were broken down by the kidney, and that the ammonia formed in this process was transformed into urea by the liver.

In view of Krebs's findings, a study of the metabolism of pyrimidines by the tissue slice method has been carried out in our laboratory. The experiments involved a study of the breakdown of various pyrimidines by tissue slices. The extent of the metabolism was determined by means of changes in the urea or ammonia content of the medium in which the tissues were suspended. In a series of experiments the effect of pyrimidines on the oxygen uptake of liver tissue was also determined.

In all the experiments there was no significant increase in either urea or ammonia formation in the presence of the pyrimidines investigated. These results seem to indicate that under the conditions used in our experiments there is no marked metabolism of these substances resulting in the formation of ammonia or urea.

The oxygen uptake of mouse liver tissue in the presence of all the pyrimidines studied, and especially in the presence of cytosine, was significantly higher than that of the controls.

The results of this investigation do not eliminate the possibility of other paths of metabolism involving the formation of substances other than ammonia or urea. The validity of the conclusions drawn from the results obtained is determined by the limitations of the tissue slice method. Since waste products cannot be removed, it is necessary to limit the duration of an experiment to a relatively short period. Consequently, if the rate of metabolism is slow, there may not be a sufficiently large accumulation of end-products to indicate a significant increase. A slow rate of diffusion of the metabolites or end-products would have the same effect. Another limitation of the method is that the cells are removed from their accustomed environment in the animal. Consequently, if the metabolite requires an activator that is not present in the cell itself or in the artificial medium surrounding the cell, metabolism will take place only very slowly and so may escape detection.

---

* Substance of a paper read before Section II (Biological Sciences) of the Eighth American Scientific Congress held in May 1940.

THE PHYSICS OF METALS*

CRYSTALLINE bodies owe many of their physical properties to the fact that they are made up of atoms which are more or less rigidly fixed in space so as to form a regular or symmetrical three-dimensional pattern. Metals and alloys consist also of ordered patterns of atoms and are crystalline. The positively charged atomic nuclei may be considered to be embedded in a matrix of surrounding negative electrons. This peculiar structure is responsible for the malleable nature of metals, for their electrical conductivity and for many other characteristic properties. Metal chemistry is thus as distinct a sub-division of chemistry as is organic and inorganic chemistry; each division depending on the particular form of bonding between atomic nuclei.

Those alloys which have valuable mechanical or physical properties, such as excessive hardness or strength, are usually not structurally homogeneous nor in true equilibrium. Consequently, it is necessary to discover not only the relative amounts of the various constituent atoms but also their arrangement in the crystalline pattern. Furthermore it is desirable to determine the particular treatment by which any required combination and distribution can be attained. Empirical metallurgical processes have been developed during the past thirty years with surprising success; but it is only recently that in certain cases the reasons for these processes have been disclosed by X-ray analysis. The ability to 'design' alloys with given properties is the next stage in the progress of metal chemistry. As an example, some advance has been made towards an understanding of the peculiar features of structure which give the new permanent magnet alloys their extraordinary power. This latter property was exhibited by a small magnet which lifted many hundred times its own weight.

The attainment of given mechanical properties may necessitate careful annealing, quenching from critical temperatures, cold working, etc. A series of X-ray analyses throughout successive stages of the process discloses some of the sub-microscopic changes which occur, and leads to a better understanding of the physics of metals and of the facts which determine their properties. Much of the X-ray work now being undertaken is resulting in the compilation of valuable data. The recent work by A. J. Bradley on the ternary systems NiFeAl, CuNiAl, and FeCuAl, discloses some of the underlying physical reasons for the occurrence of certain phases or types of crystalline pattern. In particular, the electron-atom ratios of the alloys appear, as was first pointed out by Hume-Rothery, to be one of the fundamental factors controlling the formation of given phases. On the assumption that iron and nickel have no free electrons, that copper has one and aluminium three, it is possible to predict approximately the phase boundaries in the conventional triangular diagrams which give the composition of these ternary alloys.

---

* Substance of the Norman Lockyer Lecture of the British Association delivered by Prof. W. L. Bragg at University College, Hull, on June 26.

MERCHANT SHIPPING IN WAR-TIME

IN *Engineering* of August 9 there is an instructive article on merchant shipping during war-time. To Great Britain at war, the preservation of the sea lanes leading to her ports is of the greatest importance. Canada can produce wheat and other essential materials, the United States can manufacture aeroplanes and military supplies, but facilities have to be available for their transport. The recognition of this need gave rise to grave concern at the relatively heavy losses incurred immediately after the outbreak of hostilities. The prompt institution of the convoy system and the active anti-submarine campaign greatly reduced such losses but as the economist observes, "So successful have they been that the seriousness of the shipping problem has not been fully recognized by the public. . . . Even if there were no submarines and no mines there would be a scarcity of shipping, for the War not only directly absorbs a number of ships in supplying the armed forces overseas, but it also greatly increases the quantities of some bulky raw materials that are required. When, in addition, the annual carrying capacity of shipping is reduced by the delays inevitably associated with the convoy system, the problem is still further increased". It is estimated that the convoy system reduces the effective carrying capacity of the merchant fleet by at least 25 per cent. Not only is the tonnage which enters the ports of Great Britain reduced by the actual destruction of vessels by enemy action, but also many neutral vessels are withdrawn from these routes. The effect of this was shown in the War of 1914–1918. In 1913 if the total of British tonnage with cargoes entering British ports is represented by 68, the foreign tonnage would be represented by 32, whilst in 1917, the corresponding numbers would be 46 and 10 and in 1918, 49 and 8.

Great activity in ship-building followed immediately after 1918. In June 1939 more than three million tons were idle and laid up, the large proportion being of British registry. The fleet of the United States showed the greatest expansion from 5·4 million in July 1914 to 12 million in 1939. The world's tanker tonnage rose eightfold to 11·4 million, held chiefly by Great Britain, the United States and Norway. The efficiency of the mercantile marine was greatly increased, the gain being estimated at about 60 per cent. Sailing vessels have all but disappeared.

The average speed has risen substantially. Oil-burning and motor-vessels have replaced the old coal burners. The British merchant marine, as well as being the world's largest, is one of the most efficient; less than 45 per cent of the ships have a top speed below 12 knots and 24 per cent have a speed in excess of 15 knots. In 1938 Great Britain launched only one million gross tons of new shipping as compared with 1·9 millions in 1913. It is considered probable that the 1940 total will approximate three million tons. For the first time in many years, shipyards in Canada and other parts of the Empire are working at full capacity. This activity will increase the new tonnage available for the replacement of losses and the continued expansion of the services made necessary by the exigencies of the War.

STRUCTURAL HINGES OF REINFORCED CONCRETE

In reinforced-concrete, rigid-frame bridges, particularly in those of long spans, it is desirable, and in many cases necessary, to introduce some form of articulation at the bases of vertical members where high deformation stresses would otherwise occur due to temperature changes and shrinkage. What constitutes a suitable hinge for such a structure can be determined only by laboratory tests in conjunction with field experience, and a paper which has recently been issued (Bulletin No. 322, Engineering Experiment Station, University of Illinois) entitled "An Investigation of Rigid Frame Bridges: Part 3. Tests of Structural Hinges of Reinforced Concrete", by R. W. Kluge, deals with this important aspect of reinforced concrete design.

The purpose of the investigation described was to obtain information relative to the structural behaviour of several types of hinges adaptable to concrete rigid-frame bridges. Besides being sufficiently flexible to permit the required degree of rotation, a properly designed hinge should be capable of withstanding both compressive and shear forces, be economical to construct and easy to maintain, and the seven examples selected for test were such as might be expected to meet these requirements.

The specimens, which included tongue and groove joints, simple pivots, a modified Mesnager hinge and a flexure fulcrum hinge, were, with one exception, made from concrete designed to have a strength of 3,500 lb. per square inch at 28 days and were tested to destruction under vertical loads, oblique loads and rotation and time loads.

While the limited scope of the investigation did not permit of any general conclusions being reached, the results provide a basis for further study. They do, however, give information as to the most suitable designs for a given type of bridge and show that under vertical load the measured strength is in close conformity with the computed strength. In most cases, favourable figures under oblique load were recorded, while, with one exception, they all permitted an angular rotation of 0·004 radian without deterioration even after 10,000 reversals. Pending more detailed investigation, the details supplied in this bulletin are therefore of considerable importance and value to designers.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Mechanical Engineering Subjects at the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (August 28).

Lecturer in Mechanical Engineering—The Principal, County Technical College, Gainsborough, Lincs. (August 29).

Lecturer in Mechanical Engineering—The Principal, County Technical College, Gainsborough, Lincs. (August 29).

Deputy Director of Education—The Director of Education and Chief Executive Officer, Education Offices, 263 High Street, Walthamstow, London, E.17 (August 31).

Professor of Physical Chemistry in the University of the Punjab, Lahore—The Secretary, Universities Bureau, 88a Gower Street, W.C.1 (September 1).

Professor of Anatomy at St. Mary's Hospital Medical School—The Academic Registrar, University of London, Royal Holloway College, Englefield Green, Surrey (September 11).

Assistant Secretary for Higher Education—The Secretary for Education, County Offices, Aylesbury, Bucks. (September 27).

Lecturer with an Honours Degree in either Engineering or Mathematics at the Royal Technical College, Salford—The Acting Director of Education, Education Office, Salford 3.

Lecturers in Chemistry, Physics, Pure and Applied Mathematics, and Engineering Drawing, for Senior Day and Evening Classes, and Lecturers in Building Science S.3, Electrical Technology A.2, Transmission and Distribution A.2, Radio-Communications, and Mechanical Engineering Subjects, for Senior Evening Classes—The Principal, Technical College, Kingston-on-Thames.

Teacher of Mechanical Engineering in the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick.

Drainage and Irrigation Engineer to the Government of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9389).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 7: The Origin of Frogs. By Prof. D. M. S. Watson. Pp. 195–232. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). 4*s*. 6*d*. [88

The Efficiency of Commercial Pasteurisation and the Phosphatase Test. By Ben Davies. Pp. 40. (London: United Dairies, Ltd.) [98

Other Countries

Henry Lester Institute of Medical Research. Annual Report, 1939. Pp. 58+3 plates. (Shanghai: Henry Lester Institute for Medical Research.) [88

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 16: Studies in Tropical Fruits, viii. Carbohydrate Metabolism of the Banana Fruit during Development. By H. R. Barnell. Pp. 39–72. (Trinidad: Imperial College of Tropical Agriculture.) [88

Annual Report for the Year 1939 of the South African Institute for Medical Research. Pp. 85. (Johannesburg: South African Institute for Medical Research.) [88

Durban Museum and Art Gallery. Annual Report for the Year ended 31st July 1939. Pp. 12+4 plates. (Durban: Durban Museum and Art Gallery.) [88

Union of South Africa: Department of Mines. Memoir No. 37: A Subject Index to the Literature of South African Geology and Mineral Resources for the Years 1921 to 1935 (inclusive). By Dr. A. L. Hall. Pp. 288. (Pretoria: Government Printer.) 7*s*. 6*d*. [88

Contributions from the United States National Herbarium. Vol. 28, Part 3: Marine Algæ of the Smithsonian-Hartford Expedition to the West Indies, 1937. By William Randolph Taylor. Pp. iii+549–562+plate 20. (Washington, D.C.: Government Printing Office.) [98

Brooklyn Botanic Garden Record. Vol. 29, No. 3: Gardens within a Garden; a General Guide to the Grounds of the Brooklyn Botanic Garden. By C. Stuart Gager. (Guide No. 10.) Second edition. Pp. 155–214. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 25 cents. [98

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 13 (Agricultural Series No. 1): Agricultural Education, Organization and Administration. Revised edition. Pp. vi+50. 10 cents. Vocational Division Bulletin No. 206 (Home Economics Series No. 23): Credit Problems of Families; a Study of Credit as a Phase of Family Financial Planning; Suggestions to Homemaking Teachers. Pp. vii+100+3 plates. 20 cents. Vocational Division Bulletin No. 207 (Trade and Industrial Series No. 58): The Fire Alarm System; an Analysis of the Work of the Fire Alarm Bureau, with a Discussion of the Problems of Training likely to be Encountered. By Frank Cushman and H. A. Friede. Pp. vii+78. 15 cents. Vocational Division Leaflet No. 1: Teaching the Control of Black Stem Rust of Small Grains in Vocational Agriculture Classes. Revised edition. Pp. iv+12. 5 cents. (Washington, D.C.: Government Printing Office.) [98

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 31, 1940 No. 3696

SOCIAL AND ECONOMIC RECONSTRUCTION

NOTHING could be more marked than the contrast between the aim of the Allies in the present struggle and that at the close of hostilities in 1918. Then everything was directed to the interests of the group, racial or national. Now we fight for the rights of the individual—justice and individual freedom. In both Wars the Allies were constrained to take up arms in resistance to the spirit of aggression, and as it was phrased on that earlier day, "to make the world safe for democracy". In the event, the victory of 1918 became the instrument of group survival. The formula of peace settlement was the application of the principle of self-determination on a national or racial basis and the safeguarding of minorities—not, be it noted, of the interests of the individuals of which those minorities were composed. In the political and economic stresses of post-War years, self-determination, unfortunately, was too readily transmuted into a claim to the right to realize national aspirations, from which in its more extreme form it was but a step to the theory and practice of the totalitarian State and aggressive nationalism. Against such a consequence of the peace settlement to come we must be on our guard. We must not allow our aim to be obscured by the dust of conflict, or refuse to profit by the lessons of the last twenty years.

When the day of settlement comes, it will be no time for the formulation of Utopian schemes of world regeneration. The arduous task of social reconstruction on a world-wide scale will demand the closest scientific study of actual conditions, in which there must be a place for a clear perception of the allowance to be made for the spiritual and emotional factors which have operated and will continue to operate in the social, political and economic spheres of human evolutionary development. In this relation the failure of the last post-War settlement was two-fold. It attempted to restore a pre-War world order which had vanished for ever ; and in so doing it ignored, or failed to appreciate, the significance of the fact that thousands of millions of pounds, the savings of more than a hundred years of prosperity, had been blown into the air. Hence it also failed to foresee the consequences—the immobilization of gold, the paralysis of international exchange of commodities, and as a vain remedial measure, the intensification of economic nationalism—the whole forming a vicious circle, from which in the years preceding the present War it was becoming increasingly apparent that there was no escape short of complete social and economic reconstruction.

While vision failed to discern objectively and on a scientific basis the new set of social and economic conditions imposed by belligerent expenditure in the War of 1914–18, the one great constructive proposal put forward as a palliative for the situation to which the War had given rise, as well as of the conditions in which it arose, the League of Nations, embodied too high an ideal for the stage of social development and consciousness of international responsibility of even the most advanced of the peoples of the world. It attempted to ignore, or to override, differences of culture and cultural history, of temperament and of constitution, social and moral ; but above all it neglected to take into account the group mentality which, as already mentioned, had been fostered and strengthened by the peace settlement—in short, the whole complex of acts and sentiments constituting the rock upon which the League eventually foundered, which may be summed up in the single term 'sovereignty'. Yet, as is so frequently pointed out, it is highly instructive to contrast the political failure of the League with its achievement in the one sphere in which it was supremely successful, namely, that of scientific inquiry in a variety of matters affecting the well-being of mankind on a world-wide scale, in which universal co-operation was possible without the intervention of particularist interests or nationalistic bias.

The contrast in the practical results which emerged in what have been differentiated thus as two spheres of the League's activities points to a difference in concept and outlook which it may seem difficult to resolve. On one side, a rationalistic world in which effort is directed to the objective scientific study of facts and principles with an ultimate view to their utility to mankind without regard to racial, national or other distinction, except in so far as these may in certain eventualities be relevant to the issue; on the other, an arena in which a contest occurs between the interests and aims of discrete groups—interests not necessarily always conflicting, but in so far as they are prepared to co-operate in a common purpose, moved by self-regarding and emotional springs of action rather than a rational and comprehensive conception of a universal aim. Yet it may be that the contrast must not be too deeply stressed. Even in the search for truth of the most detached rationalist, something of passion and emotion must enter to inspire his disinterested devotion to an ideal; while in the give and take of the conflict of groups, emotion alone, even of the most fervent patriotism, has not sufficed to bring about those settlements and compromises in the less spectacular political fields in which the League of Nations has achieved some success, even if it failed on a larger and more conspicuous stage.

This phase of the League's activities is now past history; but its lessons cannot be too deeply pondered with a view to the future. After all, it was a great achievement that the chief powers of the world should have been brought together with the common object of discussion of affairs on a world basis with the view of attaining conditions favourable to the preservation of peace. It was in its mandate policy that the League of Nations perhaps approached most closely to what we should now stress most strongly as the true end of government. It insisted upon the rule of the mandatory Power being framed and directed in the interest of the native population. The well-being of the governed determines the nature and form of government. The State exists for the benefit of the individual and not the individual for the ends and purposes of the State, whether as a unit engaged in a group struggle or as embodied in the persons of a ruling class.

If we accept the fullest development of individuality as the true end of government, not merely individual freedom but also justice must follow as a corollary to ensure the mutual respect of individual rights. That at times the claims of the State must override all individual rights, as in recent legislation in Great Britain, may in the ultimate analysis be regarded as no more than a supreme affirmation of those rights in totality, to which all and every one individually will assent in the interest of all.

How best these interests may be safeguarded in the future, and in what conditions it will be possible for mankind to enter upon the approach to the great social and economic reconstruction which cessation of hostilities will imperatively demand, are problems which still have to be solved. The first essential, it would be generally agreed, must be to bring about such relations between peoples as will ensure the preservation of peace. In the long history of the development of human society, the advancement of the individual and the preservation of the conditions which promote peace both internally and externally in a given group have seen the continual formation of larger and larger groups, held together by emotional, social and economic bonds. Hence the belief that only on some distant day when mankind will assent to a state of world federation will peace be assured. The recent history of the League of Nations would suggest that that day is far distant; but we may perhaps draw inspiration from the remarks made by Mr. Winston Churchill in the House of Commons on August 20 referring to relations between Great Britain and the United States. As he put it, "these two great organizations of the English-speaking democracies . . . will have to be somewhat mixed up together in some of their affairs for mutual and general advantage"; an inevitable process which he compared in homely terms to the mighty waters of the Mississippi "rolling along". This collaboration in the field of defence may yet be the starting-point for a new form of world co-operation in which all men of goodwill, irrespective of creed, race or nationality, may play their parts in the advancement of civilization.

THE ANUAK

The Political System of the Anuak of the Anglo-Egyptian Sudan
By Dr. E. E. Evans-Pritchard. (Monographs on Social Anthropology, No. 4: Published for the London School of Economics and Political Science.) Pp. viii + 164 + 12 plates. (London: Percy Lund, Humphries and Co., Ltd., 1940.) 7*s.* 6*d.*

THIS volume is a noteworthy production from three points of view. In the first place it provides valuable information about a people concerning whom so little was previously recorded that they may be regarded as practically unknown. Secondly, it fills a gap in our knowledge of the great Shilluk-speaking group (though it must be confessed that it suggests a whole series of new questions), while thirdly, from the practical point of view, that is, that from which the work was organized, it has provided the Government with definite information concerning the sociology of a difficult and restless tribe whose administration has hitherto been unsatisfactory.

The Anuak are a Shilluk-speaking tribe of some 30,000–40,000 souls, inhabiting the country of the Baro and Pibor Rivers (themselves affluents of the Sobat) and their tributaries. Part of this territory lies in the Sudan, much of it extends into Abyssinia, and it is this political spread that constituted one of the Government's difficulties, for guns were readily procured in Abyssinia and rebels and trouble-makers could easily cross the border. This they sometimes did, carrying with them the royal insignia, of which we shall presently speak, and thus increased unrest and rendered more troublesome the administration of what is geographically a difficult country.

Linguistically the Anuak are more nearly akin to the Acholi of the south than to the Shilluk. It may be that there are also resemblances in their social organization. On the other hand, the Anuak claim common origin with the Shilluk, and the Anuak kingship certainly resembles that of the Shilluk rather closely, though perhaps not so closely as has hitherto been imagined. Since the author's chief aim was to discover what the Anuak political and royal systems really are, it is only natural that the greater part of this volume is devoted to these particular features. At the same time there is enough information to enable us to appreciate some of the general similarities that the Anuak show to other Nilotic tribes. Indeed there are hints that at one time the Anuak may have more closely resembled other Nilotes than they do at present, when they are predominantly agricultural. Actually considerable difference was found between the eastern and western portions of Anuak territory. In the west it seems that a more primitive condition persists; there is little inter-village organization and the authority of the headmen is for the most part limited to their own village or village group. In the eastern portion of the territory there is a closer relation between villages, and the system of headmanship has given place to a system of nobility and kingship, the latter, be it noted, very much more ritual than executive.

We may best approach the Anuak kingship and its insignia by considering their system of nobility. All nobles, *nyiya* (sing. *nyiye*) are members of a single group, and one member of this group who is in physical possession of certain beads, spears, stools and other objects—the insignia of kingship—is king. It is possible that at one time the insignia passed regularly from father to son, but this has not been the case for several generations. No *nyiye* being sufficiently powerful to retain the insignia for life—should he try he would be killed by a rival—it became more and more the practice for the holder to surrender them to a rival after a year or two, perhaps after some not very determined fighting. A complication—and, from what the reviewer learnt of Anuak affairs before Dr. Evans-Pritchard's investigation, it was this complication that presented the chief difficulty to the Government—was that though every Anuak ruler belongs of necessity to a particular clan with patrilineal descent, he does not become a *nyiye*, eligible for kingship, unless he is invested with the insignia of kingship, nor can the son or descendant of any man not so invested ever become 'king'. Thus every *nyiye* has in fact been king, if only for a few hours. There is no special word for king (unlike the Shilluk), and all nobles display identical signs of rank and are saluted and buried in like manner. When therefore a few years ago, after some rather mixed fighting, the then king withdrew across the Abyssinian frontier taking the insignia with him—at a time before the *nyiya* system was understood by the Government—the possibility of serious political trouble was not far distant.

There is a considerable cult of dead kings at their tombs, and trees that spring up in the immediate neighbourhood are regarded as sacred. Dead kings manifest themselves as snakes, as also do nobles. Sacrifices are made, and the old kings are thought to come from their tombs in their snake form to acquaint themselves with their successors.

In conclusion, it may be emphasized that this volume demonstrates what a capable anthropologist with a general knowledge of the ethnology of an area can learn in a few months by intensive inquiry on particular matters, even when he does not speak the language of the people concerned. During the ten weeks spent on this investigation much time was occupied in actual trekking, 400–500 miles of difficult country being covered on foot, while the average length of stay in each village was about one day. Moreover, the author's serious illness restricted inquiries in the Pibor area. Arabic was the medium of most of the interpretation, though, speaking Nuer, Dr. Evans-Pritchard could sometimes make good use of this language.

C. G. SELIGMAN.

ALPHABETICAL CHEMISTRY

(1) Kingzett's Chemical Encyclopædia

A Digest of Chemistry and its Industrial Applications. Revised and edited by Prof. Ralph K. Strong. Sixth edition. Pp. x + 1088. (London : Baillière, Tindall and Cox, 1940.) 45*s*.

(2) A New Dictionary of Chemistry

Edited by Dr. Stephen Miall. Pp. xv + 575. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1940.) 42*s*. net.

IN the preface to his "Dictionary of Chemistry", published in London in 1795, William Nicholson remarked that "the form of a Dictionary, though, for many years, in high estimation with the world in books on every subject, is confessedly inimical to the natural order of things". Macquer had justified the alphabetical arrangement in his earlier dictionary on the ground that chemistry was then little more than a collection of facts, scarcely entitled to the name of science, or capable either of synthetic or analytic explanation. While pointing out that the progress of chemistry in the interim had been uncommonly rapid, Nicholson urged that "the science of Chemistry possesses little system", in consequence of which "the utility of a dictionary to the Learner will more than compensate for the offence given to the Masters of the Science".

This apology for the chemical dictionary makes strange reading in an age that is able to survey the truly remarkable systemization of chemistry, following the introduction of the atomic theory at the beginning of the nineteenth century and the consequent development within the same century of precise ideas concerning molecular structure and classification of the elements, together with the later ordered expansions into the fields of electronic and sub-atomic chemistry.

Systemization is the keynote of modern chemistry ; and this highly organized branch of science not only tolerates, and indeed demands, the general dictionary serving the needs of the modern analogue of Nicholson's "Learner", but it calls also with equal insistence for specialized dictionaries designed for the successors of his "Masters of the Science". Nor does the chemical specialist confine his attention nowadays to compilations of this second class. Although he makes full use of such specialized dictionaries as Richter's formula-index and Heilbron's name-index of organic compounds, he is equally at home among the pages of Thorpe's "Dictionary of Applied Chemistry" or Ullmann's "Enzyklopädie der technischen Chemie".

Some eighty years ago, Dr. Sheridan Muspratt produced the best-known general chemical dictionary, in the English language, of that age. Of him it was written by "the distinguished phrenological artist", Bally : "You have one of the largest brains in proportion to your size, which constitutes a strong mind . . . great energy—indomitable perseverance ; you possess love of fame or approbation in a very high degree . . . the moral faculties are very good". From this intriguing diagnosis it appears that even in the childhood of modern chemistry the chemical lexicographer had to be a man of parts, animated by powerful incentives. At the present day the domain of chemistry is so vast, and the consequent task of selection has become so onerous, that even a modern Muspratt might well hesitate at the foot of the mountain from which he has to produce his mouse. It is therefore not surprising that the compilation of such works has become increasingly dependent upon the co-ordinated activities of teams of experts, and that some of these alphabetical expositions of chemistry have started as modest dictionaries and grown into encyclopædias in their later editions. The distinction between chemical dictionaries and encyclopædias is not clear, but it would seem to depend mainly upon conciseness.

(1) "Kingzett's Chemical Encyclopædia", by virtue of its wide range and fairly detailed treatment of individual items, is perhaps better

described as an encyclopædia than a dictionary, although either title could be reasonably applied to a work of this scope. "Kingzett" is now something of a household word among chemists. It first appeared in 1919, and the aim of the author, as expressed in his own words, was "to prepare an epitomized digest of chemistry and its industrial applications, in a form which should be useful as a work of reference by all classes of the community". As mentioned by the late Sir Gilbert Morgan in a foreword to the present edition, the production of this work was a labour of love to which Mr. Kingzett devoted most of his leisure towards the close of a successful industrial career. Some time before his death, Mr. Kingzett entrusted to Sir Gilbert Morgan the revision of his annotated fifth edition; but eventually this important duty was transferred to Prof. R. K. Strong, professor of chemistry and chemical engineering at the Rose Polytechnic Institute, Terre Haute, Indiana, who became editor-in-chief of the sixth edition.

Prof. Strong has performed his task admirably. Kingzett's "Encyclopædia" has constantly improved since its original appearance, and in its latest form it contains much new material, including numerous graphs, diagrams, charts, and tabulated data. The treatment of physical chemistry and engineering chemistry has been extended, and the economic aspects of chemistry receive more emphasis than in the earlier editions. That a liberal view of the province of such a work has been adopted is further shown, for example, by the inclusion of a special article of seven pages on bacteria. Copious references to special sources are given at the end of important articles: this is a valuable feature of the work. To choose a few entries at haphazard, here the inquirer will find reliable information on such diverse subjects as chemical plant, colloid chemistry, electricity, heavy hydrogen, gassing, glyptal, nitrogen fixation, paints, petroleum, sherardizing, 'Staybrite', tung oil and wave-lengths.

(2) There is no difficulty in classifying Dr. Miall's new work as a dictionary, rather than an encyclopædia, of chemistry. With the help of numerous experts, whose names are given, he has produced an alphabetical treatment of remarkable conciseness, comprehensiveness and clarity. As a measure of the book's conciseness it may be noted that an average page may contain from about five to fifteen entries. The chemical elements and their important derivatives and minerals, together with a large and representative selection of organic substances, are assigned separate headings. Chemical change and individual chemical reactions of importance are treated from various points of view. Diagrams have been used sparingly, but there are copious structural formulæ and many valuable tabular statements. The humanistic aspect of chemistry finds an expression in brief accounts of noteworthy chemists of these and former days, interspersed in the alphabetical sequence. References to other sources of information are sometimes given in individual articles, besides which there is a list of representative books dealing with the main divisions of chemistry. The volume also contains a convenient table of physical constants of nearly two thousand organic compounds described in the text.

As Dr. Miall recognizes in his introduction, omissions and errors are inevitable in a work of this kind, particularly in a first edition. Up to a point also, the selection or rejection of individual items must be determined by arbitrary decisions. In following out a specific inquiry we found, for example, no entry under the headings of antiseptics, bacteria, disinfectants, germicides, or sterilization; nor could we discover any note on 'Nylon'. The structural formulæ are impressive in their neatness, but we notice that quinquevalent and tervalent carbon atoms—those ineradicable weeds in the garden of organic chemistry—rear their familiar heads in the representations of α-cadinene and phellandral. Menthone is wrongly described as an aldehyde, and it is only partly converted into isomenthone under the conditions mentioned. The odour of piperitone resembles peppermint rather than camphor. Some of the biographies (for example, the first two on p. 320) call for revision.

There is no need to multiply allusions to the fine detail of the work. Viewed as a whole, it forms a really valuable addition to the literature of general chemistry. Dr. Miall and his collaborators have produced a very handy and attractive chemical dictionary, which by reason of its simple and concise style, interesting presentation, and neat format will be welcome to a great variety of users ranging from teachers and students, engineers, pharmacists, medical men, and the intelligent layman in general, to chemical technicians and specialists. It is a work that will inevitably be found in a well-thumbed condition upon the shelves of reference libraries of all kinds.

It may be added that Dr. Miall's expressed intention of enlisting the help of American chemists in bringing out a revised edition of this work at a later date appeals strongly to a reviewer who has held for many years that increasing Anglo-American co-operation in the field of general chemical literature should be a primary aim of all English-speaking chemists.

JOHN READ.

ARCTIC AND ANTARCTIC

(1) Two Men in the Antarctic

An Expedition to Graham Land 1920–1922. By Thomas Wyatt Bagshawe. Pp. xxi + 292 + 33 plates. (Cambridge: At the University Press, 1939.) 15*s.* net.

(2) Greenland Journey

The Story of Wegener's German Expedition to Greenland in 1930–31 as told by Members of the Expedition and the Leader's Diary. Edited by Else Wegener, with the assistance of Dr. Fritz Loewe. Translated from the 7th German edition by Winifred M. Deans. Pp. xx + 295 + 47 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 12*s.* 6*d.* net.

(3) Arctic and Antarctic

The Technique of Polar Travel. By Colin Bertram. Pp. xii + 125 + 13 plates. (Cambridge: W. Heffer and Sons, Ltd., 1939.) 7*s.* 6*d.* net.

THESE three books together touch most sides of polar interests and in some ways each is complementary to the other two. Two of them are accounts of expeditions, one to the north, with abundant modern equipment, the other to the south with a minimum of outfit and even of preparation. The third volume looks objectively at the whole game and is a discussion of the technique of polar travel. They are all books of interest and value, written by travellers of wide experience.

(1) Mr. Bagshawe with Mr. Lester were two of the four members of a much-noised expedition to Graham Land in 1920, that held out promises of great achievement. But the expedition fell short of all hopes, and when the leader returned with the whaler that carried his men, these two decided to stay. They were not made of the stuff that gives in. In a hut built of a boat and packing cases, with a few stores and much penguin and seal diet, they survived the winter in good health. True, they were in one of the mildest parts of Antarctica, the west of Graham Land, and it was equally true that, through lack of equipment, they attempted no long journeys. Thus they made few discoveries, though their meteorological and biological observations were of value. The chief place, however, that the venture will take in the story of the Antarctic is the proof it affords that men of resource can survive in the Antarctic on little beyond the produce of the sea. It is a spirited, buoyant narrative, written in vivid chapters and well illustrated.

(2) The second volume, which is translated from the German, is by the widow of Dr. Wegener, the well-known geographer who lost his life in the German expedition to the ice sheet of Greenland in 1930–31. It is a composite book, incorporating the narratives of various members of the expedition. It supplements previous volumes on the subject. The expedition was planned with great thoroughness and foresight, and had serious scientific aims. The thickness of the ice sheet was to be measured by sonic soundings; deep shafts were also to be cut for temperature observations, and gravity determinations were to be made at various stations. Lastly, the climate of the interior of Greenland was to be studied with the help of a winter station in the interior at a height of about ten thousand feet. On the west coast on Umanak Fjord and on the east coast on Scoresby Sound there were also to be stations. Much of the work was successfully carried out, but the difficulties were great. The mechanized transport that was to be used to carry the hut and stores to the interior proved unreliable. Moreover, the surface was worse than had been expected, and the Greenlanders did not prove good travellers on the ice-sheet. With great difficulty the central station of Eismitte was founded, 250 miles from the coast, but it was little more than a series of deep holes in the ice. However, two men survived the winter in its chilly depths and did their work. Dr. Wegener, the most experienced member of the party, lost his life in a journey from Eismitte to the coast, and other members suffered severely. But the work was done and the book, apart from its thrills and tragedies, is a record of great achievement and embodies many facts of value. There are good maps and illustrations.

(3) Mr. Bertram's book strikes a new note. With experience in the Arctic on Bear Island, that desolate spot in the Barents Sea, and in East Greenland, he joined Mr. Rymill's three-year expedition to Graham Land. Thus he is fully qualified for his task. The book is not long, but it covers the ground adequately and is written in a fresh and direct style, singularly free from the customary conventions of books of polar travel. Here is the truth as regards not merely equipment, food and transport, but more important still the reaction of the individual to the polar environment. The book is all the more vivid for having been written, at least in part, in sledge camps in Graham Land. Trial and error are at the base of all polar technique, but tradition has tended to clog progress and not enough attention has been paid to the lessons that Eskimo can teach. Science, of

course, has minimized the chance of disease and has done much to improve transport, but perhaps the greatest advances in polar technique in recent years have been due to the extreme youth of many recent polar travellers. In happier days the Arctic at least became almost a holiday ground for the youths of our universities, and they were ready to throw aside tradition and try new methods, often with great success. This is one of the most interesting polar volumes of recent years, and is admirably illustrated by drawings and photographs.

R. N. R. B.

THE THEORY OF GROUP REPRESENTATIONS

The Theory of Group Representations
By Prof. Francis D. Murnaghan. Pp. xi + 369. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1938.) 22*s*. 6*d*. net.

FELIX KLEIN'S famous enunciation—"Given a manifold and a group of transformations of the same, to develop the theory of invariants relating to that group"—not only describes the spirit of geometry but also reveals that the concept of a group dominated at least one important branch of mathematics. In the fundamental structure of other branches, however, groups are to be found, and the general concepts developed during the latter half of the last century both by Klein and his student friend, Sophus Lie, were responsible for the far-reaching influence which the relevant theory has had on modern mathematical thought. It is not always easy to discover the first important application of a newly developed theory but it is probable that the formulation of the mechanics of the atom made by Heisenberg in 1926 by the application of the theory of matrices—the invention of Cayley in 1858—is a fair illustration of the excursion of that theory into the practical domain.

In 1926 also, Herman Weyl wove the group theory into the fabric of quantum mechanics. Indeed, the revolution in modern physics may be said to have begun in that year by the work of Heisenberg, Dirac and Weyl. The vast theory of differential equations, and especially the Hamiltonian equations of higher dynamics, became far clearer under the lens of continuous groups, the theory of which was almost exclusively the work of Lie. As Prof. E. T. Bell aptly remarks: "The far-reaching power of the theory of groups resides in its revelation of identity behind apparent dissimilarity. Two theories built on the same group are structurally identical. The more familiar is worked out; the results are then interpreted in terms of the less familiar".

Bearing in mind this brief outline, it is instructive to turn to Prof. Murnaghan's treatise. In the preface of this book the author states that he has "attempted to give a quite elementary and self-contained account of the theory of group representations with special reference to those groups—particularly the symmetric group and the rotation group—which have turned out to be of fundamental significance for quantum mechanics, especially nuclear physics". Special attention has been given to the theory of group integration, as developed by Schur and Weyl; to the theory of two-valued or spin representations; to the symmetric group and the analysis of direct products; to the crystallographic groups, to the Lorentz group and the concept of semi-vectors as developed by Einstein and Mayer.

The text begins with a lucid treatment of the group concept leading to its representation. Matrices are thus introduced and canonical forms discussed. Then follows a general chapter on reducibility in which Schur's lemma on irreducible collections of matrices, the theorems of Burnside, Frobenius-Schur and Auerbach are considered. The Kronecker product and powers form the substance of Chapter iii; the symmetric group and its characters, the alternating group and linear groups occupy Chapters iv–viii, and the remaining five chapters are concerned chiefly with group integration, the orthogonal group, spin representations of the rotation group, the crystallographic and the Lorentz groups.

The mathematical development of the theory has been skilfully carried out with clarity and rigour, whilst the printing—by no means simple—is a model of efficiency and painstaking care. There are no exercises nor applications although the author points out that, with the co-operation of Prof. J. A. Wheeler, a chapter on the actual applications of the theory to the concrete problems of nuclear physics was originally planned for the volume, but, unfortunately, space considerations prevented its inclusion. This is undoubtedly a disadvantage for it would have added greatly to the interest of the student. However, the author has promised to deal with these important applications in a future publication, and this will be a welcome sequel to the present treatise. It may be added that four pages of references to relevant books and papers are given at the end.

F. G. W. Brown.

SCIENTIFIC ORGANIZATION OF WORK

A Chance for Everybody
A Liberal Basis for the Organization of Work. By Hyacinthe Dubreuil. Pp. xvi + 270. (London: Chatto and Windus, 1939.) 7*s.* 6*d.* net.

THE essential idea which M. Dubreuil expounds in this book he has already put before scientific workers in Great Britain in papers presented before the Department of Industrial Co-operation of Section F (Economics and Statistical Science) at meetings of the British Association in 1931 and again in 1934. His advocacy of co-operative contact work by autonomous workmen's teams was further discussed at recent management conferences at Oxford. M. Dubreuil now gives us not merely a fuller exposition of his detailed ideas but also something of the philosophy which has led him to offer this solution to the problem of mechanization, particularly in large organizations.

M. Dubreuil starts by asserting that scientific organization of work will only complete its evolution when it succeeds in bringing into play not only the physical capacities of the worker but also all the intellectual and moral forces that a man can develop when he works in a state of perfect freedom. It is in this sense he speaks of 'chance'—not merely opportunity but scope, the chance to try one's luck, to reap the fruits of the application of one's intelligence to life's infinite possibilities. Only as industrial organization opens before every worker this vista of 'chance' does M. Dubreuil believe it is possible to eliminate the frustration and depression with which mechanization has afflicted many of the workers in modern industry. The real problem is in the transformation of the relations that men maintain among themselves, and not the relations between a man and his tools.

This is the key idea in M. Dubreuil's scheme: it is not enough to improve material conditions by measures of protection and assistance: we must also supply the means by which the workers can attain to the combination of satisfactions that makes life worth living. If undoubtedly education has a part to play here, M. Dubreuil believes that work can and should be organized to permit the expression in it of human personality, and that such expression should not be confined merely to leisure hours.

On this ground alone, M. Dubreuil's plea for the study of the functions and possibilities of the small unit or group deserves attention. To concentrate, as has been the tendency of late, on leisure as providing the sole source of expression of personality or creative capacity for the majority of workers, even if the tendency towards increasing leisure were unchecked, is to doom men to drudgery for a large part of their waking hours. At best it is a defeatist attitude. At the worst it may rob mankind not merely of moral and intellectual satisfaction but even of technical achievements and possibilities of material advance because men are denied the opportunity of giving expression to their innate abilities.

The weakness of other systems, the reason why large organizations fail to achieve the expected results, the failure even of workers' ownership of factories and their control of purchases and sales, M. Dubreuil attributes fundamentally to the payment of wage earners by time and the apparatus of constraint which the clocking-on system involves. The inner urge towards constructive thought and action can only operate when men are assured that the fruit of their ingenuity will be theirs without restriction.

M. Dubreuil does not claim to be the originator of his basic idea of functional autonomy. His debt to J. B. Godin is freely acknowledged. But in his firm rejection of the wage system because it excludes the idea of chance and discourages the worker from putting forth all the effort of which he is capable, he takes Godin's ideas further and enunciates four fundamental rules or principles for the application of his system. These rules or principles are:

(1) Free recruitment of workers by their collective unit, constituted as a co-operative labour group.

(2) Collective undertaking of specified work for a price agreed between the employer and the delegate of the co-operative labour group.

(3) The workers grouped in the collective undertaking themselves choose their leaders and freely organize the execution of the work entrusted to them.

(4) Distribution of the total price of the work among workers according to the method of sharing judged by them to be suitable.

M. Dubreuil believes that such groups organized within a large undertaking by some species of molecular change could revivify them and avert some of the inertia which is liable to overtake them. Not only is each member of the group interested in giving the highest possible value in his own contribution, but he is equally interested in a similar raising of the standard on the part of all the others, and consequently in helping them when the opportunity arises. This form of co-operative group, moreover, avoids the obstacle which severely impedes the promotion of manufacturing co-operative societies. It demands neither the administrative capacity nor the capital which the workers usually lack and requires only their personal capacity for work, knowledge and tradesmen's competence—the only capital they can be expected to put into a common pool.

M. Dubreuil's arguments are supported by interesting examples of collective payment on these lines, and his proposals are not to be lightly dismissed either by those embedded in the traditions of existing organization or by the socialist equalitarian. Whether or not this idea of autonomous groups is capable of general application it is at least highly suggestive, and many scientific workers themselves could corroborate the accuracy of some of M. Dubreuil's arguments and suggestions. At least the idea deserves careful exploration, for we can afford to miss no opportunity of releasing those forces or capacities of the individual which the modern industrial age does so much to atrophy. Scientific workers have their own particular problems on which M. Dubreuil's ideas have their bearing and they may well be grateful to Mr. R. J. Mackay for this admirable translation and the excellent note which he contributes to introduce the volume to a British public.

R. BRIGHTMAN.

DUAL-PURPOSE COWS

Dairy Cattle and Milk Production

By Dr. Clarence H. Eckles. Third edition, revised by Ernest L. Anthony and Prof. Leroy S. Palmer. Pp. xv + 520. (New York: The Macmillan Company, 1939.) 18*s*. net.

THIS is a work of great merit, and can be recommended to all interested in agriculture, both farmer and student, in the United States of America and also in Europe. It has been written in a practical vein, but the fullest use has been made of the findings of the research worker of recent years, and there is the feeling that the latter and the practical agriculturist are in certain respects brought closer together.

The distribution of the material among the thirty-three chapters is good, with the result that a great deal of ground is usefully covered. Chapters iv–x, dealing with the breeds of cattle and to some extent with their classification, are on the whole excellent. The British agricultural student might be forgiven for criticizing some of the material in Chapters ix and x, and it is unfortunate that use is still being made of the term 'dual-purpose' in reference to cattle. It is among the most dangerous of words, particularly when used in conversation with a student. No two breeders ever have the same thing in mind when they use the word. The definition of the term at the beginning of Chapter x appears a little unconvincing to the writers themselves, and is undoubtedly so when read with preceding and following pages.

Under the heading of dairy temperament on pp. 26 and 27, we read "The cow that shows these characteristics to a marked degree—*the ability to fatten naturally towards the end of a milking period* —is said to have a good dairy temperament". If there is one quality that characterizes a Shorthorn more than another it is precisely this quality. Notwithstanding this, we find this breed discussed in Chapter x under 'dual-purpose cattle'.

My chief objection, however, is to the use of the term at all with reference to a breed. There are cows in every breed, including Jersey and Guernsey, with all the defects which are alleged to make up a dual-purpose breed. Fig. 6 on p. 27 illustrates this. Finally, students are always in doubt as to the merits of a cow in late lactation or when dry if she carries a good deal of flesh at that time. Such a cow will in nine cases out of ten be described as a dual-purpose cow, when she is probably a first-class dairy cow.

There are dairy breeds and beef breeds, both of which fit in with specific and often widely differing systems of farming. There are other systems of farming less well adapted to the ideal requirements of these breeds. Any breed farmed under these conditions for a long enough period tends to develop those characteristics which to-day we speak of as dual-purpose.

The use of the word has up to now been badly misunderstood in its application to cattle, and it would be better if it could be abolished. Among breeders of dairy cattle it is all too often a term of abuse, whereas any breed that can from generation to generation stand up to conditions not ideally suited to maximum production is a breed that must play an important part in the agriculture of many parts of the world.

The authors are to be congratulated on a good piece of work.

K. W. D. CAMPBELL.

MATERIALS OF CONSTRUCTION

(1) Materials of Construction

Their Manufacture and Properties. By the late Prof. Adelbert P. Mills. Second, third and fourth editions, edited by Harrison W. Hayward. Fifth edition, rewritten and edited by Prof. Lloyd F. Rader. Pp. xii+564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s*. net.

(2) Johnson's Materials of Construction

Rewritten and revised by Prof. M. O. Withey and James Aston. Eighth edition. Pp. xxii+867. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

FOR many years each of these two books has been recognized as a standard work on the subject of the materials used in engineering construction, and these new editions have therefore to be judged not by the criteria applied to new and untried works but in order to see how far they have been brought into line with current knowledge and practice. Though they deal with the same subject, the two books bear the stamp of individuality which may be traced to the impress of the original authors.

(1) In the fifth edition of Prof. Mills's book, his successors have retained his original purpose of providing a text-book covering the manufacture, properties and uses of the more common materials of engineering construction. His plan was to put the information in a concise and thoroughly modern manner, and though intended primarily for use as a text-book of a somewhat elementary character, the treatment was in many respects sufficiently detailed for the book to serve as a work of reference for the practising engineer..

Herein is to be found one reason for the success of this book, for it is essential that every engineering text-book without exception should have this practical orientation. If the subject is not presented with due attention to its applications in the best engineering practice, the book becomes merely a scientific treatise and must fail to find acceptance as an engineering text-book. Thus, properties of materials are not merely exhibited and discussed, but are also related, on one hand to qualities of the raw materials and to the nature of the manufacturing processes and treatments and, on the other hand, to the wide range of possible uses to which they may be put.

This valuable mode of treatment which provides the student and the inexperienced engineer with the means of weighing the pros and cons and of making the right use of new and improved materials, properties and qualities, has been well maintained though the matter has undergone considerable change. The fundamental properties of materials are treated and the methods of testing described in the early part of the book, where also such subjects as slip, progressive fracture under repeated stress, creep and corrosion are discussed.

Besides the usual range of information regarding the properties of metals, stone, concrete, timber, etc., the subjects of metallography and the constitution of metals, now recognized to be of great importance to the engineer, have received greater prominence. Of the more recent materials to come into use, the bitumens, the plastics and the protective coatings have received attention.

(2) The second of these two books has had a much longer history, having been originally published in 1897 and having had a total issue of thirty-seven thousand copies. Its author, Dean J. B. Johnson, clearly realized the importance of accurate knowledge of the mechanical properties of materials in the rational designing of any kind of construction. At that time the investigation of the properties of materials was in its infancy, and this knowledge can only be obtained by patient, expensive and competent research. It is also to be noted that the field of investigation extends, as it were, in three dimensions by the introduction of new materials, by the evolution of new qualities of these and by the extension of the conditions under which they have to serve.

Thus the outlook to-day is much wider than forty years ago, and in order that this book should be as fresh in its attitude and as enlightening in its presentation as it was then, the assistance of experts has been called in so that the information given is as thorough as it is reliable. Taking timber as an example, there is a chapter on the characteristics, properties and uses of wood, in which one section deals with the identification of different kinds. The next chapter treats with deterioration and preservation of timber, while a third gives its mechanical properties, including comparative figures for green and air-seasoned woods. Here also a section gives particulars of the strength of nails, screws and spikes in use with timber.

With similar thoroughness the other materials are presented, the treatment in this volume being in all cases more complete than in the former. Both, however, are excellent within the limits of their scope and may be accepted as fully maintaining the high reputation they have already merited.

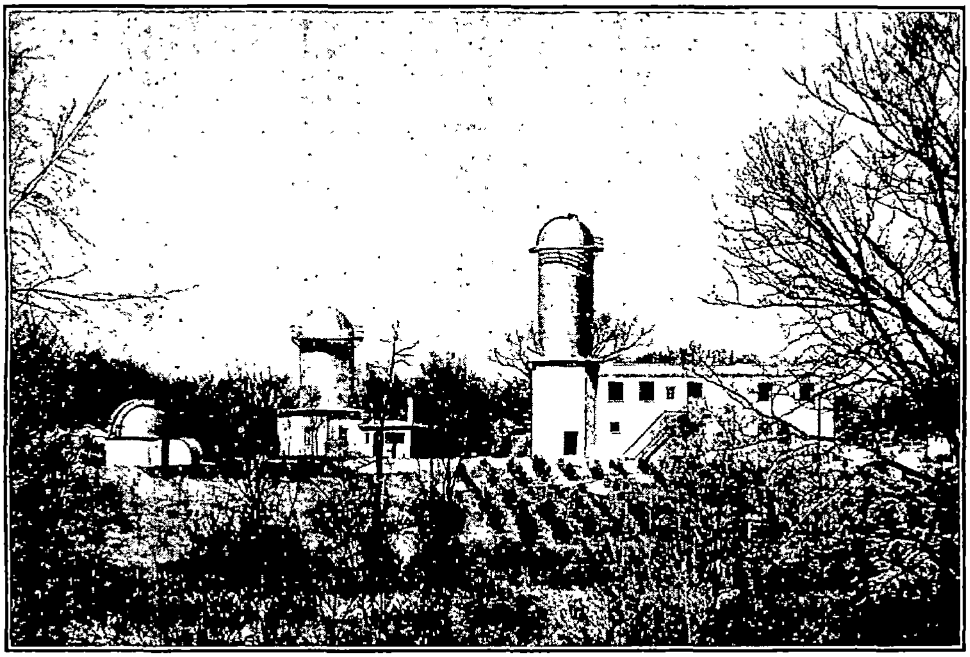
THE McGREGOR BUILDING AND TOWER TELESCOPE OF THE McMATH-HULBERT OBSERVATORY

By Dr. Robert R. McMath

WITH the dedication of the new McGregor Building and Tower Telescope on May 25, 1940, the McMath-Hulbert Observatory of the University of Michigan became perhaps the most complete and powerful installation on earth for the study of the sun. This new addition brings to a total of three the buildings of the Observatory, located at Lake Angelus, Pontiac, Michigan; and besides affording opportunities for studies of the heat, magnetic, and other energy conditions of the solar surface, gives the Observatory much-needed working and office space together with a beautifully equipped modern machine and instrument shop.

The new building is two stories in height, covering an area of 5,600 sq. ft., with the tower forming part of the building at the south. On the first floor is a drafting room, the machine and instrument shop, small film storage, cutting, and dark rooms, and a long laboratory room. The offices are on the second floor, as well as a measuring room, a large dark room with unusually complete equipment for photographic work, a second long laboratory, and the library with a projection booth for showing motion picture films of solar phenomena for study.

To minimize any risk from vibration, the tower and its foundations are of unusually massive construction throughout. Actually, the tower consists of two steel shells, one within the other. The outer tower carries the dome, the floors and other structural elements, and an electrically driven steel elevator which rises in the space between the two towers to carry apparatus to the dome-level. The inner tower carries only the telescopic light-gathering mechanism (cœlostat), which receives the light from the sun and sends it vertically downward in the inner tower and through the various optical parts of the tower telescope proper. Openings in the two steel towers at the levels of the first and second stories make it possible to send the sunlight gathered by the cœlostat mirrors horizontally in to the various pieces of apparatus in either of the two long laboratory and observing rooms which form lateral extensions of the tower. The machinery of the cœlostat in the dome and for other optical parts is not yet in place, but will be made in the instrument shop where any delicate piece of apparatus, large or small, can be quickly constructed.



McMath-Hulbert Observatory from the south-east. The new McGregor Building and 70-ft. lower telescope is at the right.

The promise of these facilities for further progress in the studies of the sun is very great. Previously, the Observatory had been impeded by lack of working space. The McMath-Hulbert Observatory was started as an amateur undertaking in 1929 by Robert R. McMath, the director; Judge Henry S. Hulbert; and the late Francis C. McMath. At that time there was only a 10½-in. reflecting telescope, housed in the smallest and lowest of the present domes. This was presented to the University of Michigan in 1931. Soon after this, a spectroheliokinematograph was attached to this 10½-in. reflector; the first successful motion-picture of a solar prominence, though now regarded as rather crude in comparison with more recent results, was secured in early August 1932, and it was soon evident that many short-lived solar phenomena could be photographed, the existence of which had not been hitherto suspected. As a result, in 1936, the 50-ft. tower telescope was erected exclusively for solar studies. During the past four years, more than 400,000 individual pictures or 'frames' have been taken with this powerful instrument, and have yielded results of great interest and value. But most of the work of design and the study of results had to be carried on in the basement of Dr. McMath's residence. This will be overcome with the greater convenience and efficiency secured through adequate facilities in the new building.

The true purpose of the new unit, however, involves even more technical considerations. The work done in the 50-ft. tower has yielded many films of motions of solar prominences through the development of an ingenious motion picture technique by Dr. McMath. The results have been in two dimensions, and from them a vast amount of evidence has been accumulated as to the character of the motions and changings on the turbulent surface of the sun, but a full study of these motions and of the forces producing them requires much more. During the past year, by means of small shifts in the lines of the spectrum due to velocities in the line of sight, motions in the third direction, that directly toward or away from the earth, have been recorded.

Many questions still remain unanswered, however. It is hoped to determine the temperatures of the streams of flaming materials, speeds of which have been discovered to be so great as ten to fifty or more miles per second. Of even greater importance, more accurate knowledge is sought of the magnetic and electrical conditions accompanying these solar storms, for the manifestations may have a connexion with such familiar phenomena as the aurora, magnetic storms, and interference with radio reception. Other considerations to be studied are the discovery of the heat changes, degree of electrical and magnetic force involved, and the determination as to whether or not the sun's output of ultra-violet light increases at such times. The instruments to be installed in the McGregor Building and the 70-ft. tower telescope will thus be much more in the field of physics than astronomy.

These are all matters relating to the actual nature and cause of solar activity—to the sources of energy and possible terrestrial effects of the movements shown on the solar films. The ways and means of research into these problems are by no means perfectly clear. Unforeseen difficulties may arise. But whatever the results, a powerful instrument is needed for the purpose of studying, through the most advanced techniques of modern physics and astronomy, these energy relations, and searching for the real reasons behind solar phenomena. What discoveries will be made no one knows, but they are sure to be of great scientific interest and value, perhaps even with a more practical terrestrial application.

The McGregor Building and Tower are so named in memory of the late Tracy W. McGregor, founder of the McGregor Fund, which has provided funds for the construction of this powerful research plant and has also made a grant for part of the support of this work during the coming five-year period.

ULTRA-VIOLET AND ELECTRON MICROSCOPY*

By Prof. L. C. Martin,
Imperial College of Science, London

THE compound microscope has now been known to science for about three hundred and fifty years, but the development of the instrument has been curiously spasmodic in spite of its admitted importance. The earliest models were perhaps looked on as little more than toys, and it was not until the publication of Hooke's "Micrographia" that the possibilities were better appreciated. Even so, it seems as if the optical design of the microscope remained for a hundred years largely as Hooke left it.

It became evident during the development of the instrument that the use of single lenses set such limits to the definition as to preclude the effective observation of smaller and smaller objects. The very diminution of the aperture of the objective, though it undoubtedly reduced the aberrations and improved the image to some degree, could not be carried too far without causing a loss of definition due, as we now know, to diffraction of light and of course to loss of illumination. We know nowadays how to build lenses which for all practical purposes are free of chromatic and spherical aberration ; but still the image is not perfect. If the object be a point source of light the image is not a perfect point but is spread into a disk surrounded by faint diffraction rings in accordance with the light-distribution first calculated on the basis of the wave-nature of light by Sir George Airy in 1834.

---

* Substance of a Friday evening discourse delivered at the Royal Institution on May 24.

At this stage it was understood that the only way to diminish the diffraction spreading is to admit the widest possible cone of light from the object into the objective. In order to control the chromatic and spherical aberrations of the objective, a highly complex construction with various kinds of glass is required. The eyepiece now consists of two or more lenses and is free from lateral chromatic aberration. With the most perfect arrangements the limit of close approach for two points in the object, consistent with the possibility of distinguishing their images, is known to be given approximately by :

$$\text{Resolving limit} = \frac{0{\cdot}5\ \lambda}{N \sin U},$$

where λ is the wave-length of light, N is the refractive index of the medium in which the object is situated, and U is the angle between the axis and the most oblique ray from an axial object point which can enter the objective and reach the image.

If the optimum resolution is required, the object is now mounted in some medium with a reasonably high refractive index, such as Canada balsam. The angle U may reach 60° or more and the product $N \sin U$ may be about 1·3 or even higher. The formula was known to be justified in the expectation that violet light ($\lambda = 0{\cdot}45\mu$) will resolve finer structures than red light ($\lambda = 0{\cdot}65\mu$). The precise limits of resolution depend somewhat on the nature of the object and its illumination, for example, whether the object manifests variations of opacity or merely variations of refractive index ; whether bright-field or dark-field illumination is used ; nevertheless, it may be taken that the formula represents fairly well the limit of possibility. What possibilities does it show in the reduction of the resolving limit ?

(1) We may try to increase N by such means as embedding the object in a medium of high refractive index like ethyl cinnamate, and using a very dense flint front lens for the microscope. There are clearly great difficulties in doing this with biological objects as a general practice, although it offers possibilities in metallography.

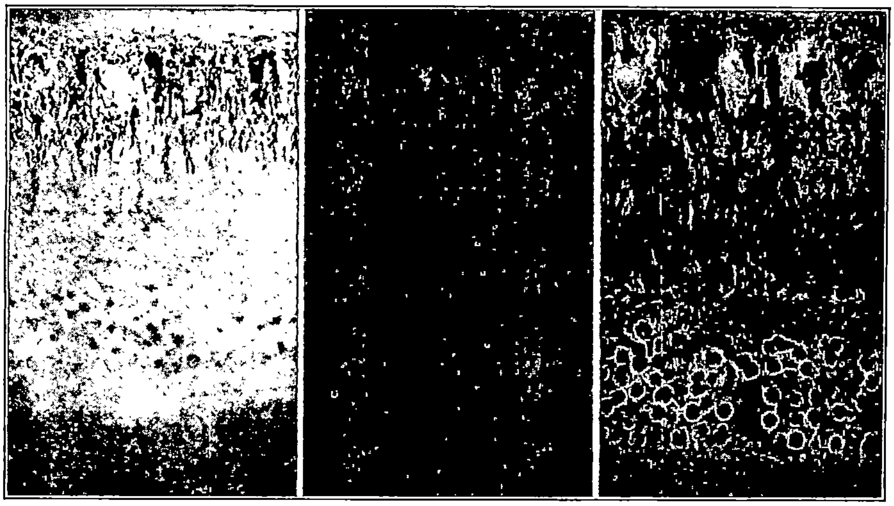
(2) We may try to increase $\sin U$ and take in wider and wider cones of rays. The chief difficulties encountered are concerned with the optical design of the lenses. We cannot make much progress along that road before the losses exceed the gains.

(3) We may diminish λ. The first ultra-violet microscopy of practical import was due to von Rohr and Kohler thirty-five years ago ; they devised a lens (monochromat) which would give an image with light of wave length 2749A. or $0{\cdot}2749\mu$, thus allowing a theoretical resolving limit one half of the amount for visible light. The light was derived from a cadmium spark, the spectrum of which contains a number of bright lines well isolated and homogeneous, so that if the light of a single spectrum line is employed there is no need to make the lens achromatic. As a result the design of the monochromat, though appearing unusual, is such that the aberrations can be kept beautifully low, and if the lens can be properly constructed its performance should be very good indeed. Fused quartz is used as the material.

The method was little applied in practice until the work of Mr. J. E. Barnard in Great Britain directed attention to its potentialities in the field of research on the filterable viruses. Barnard transformed the technique, with the aid of the firm of Messrs. R. & J. Beck, Ltd., so that ultraviolet photomicrography became relatively easy to carry out. Further studies on the technique were carried out by Mr. Johnson and myself at the Imperial College with the view of teaching, and regular instruction has been given ever since 1928.

The use of ultra-violet has many important advantages, however, even if the extreme limit of resolution is not sought after. One is that when using the ultra-violet we can employ a smaller numerical aperture, that is, use a lens taking a narrower cone of light ; then, while retaining equally good definition as with the ordinary lens, we can obtain a somewhat greater depth of focus and get a better picture with a comparatively thick object than with visible light. Again, when 'transparent' objects have to be examined under the microscope, the usual method is to stain them with various dyes which are usually taken up differentially by the various parts of the structure ; but it has been found that differing biological structures vary greatly in their relative opacity to ultra-violet light. Most become opaque at some wave-length, but some will transmit farther into the ultra-violet than others. This can be illustrated by a photograph showing how the structure of a microtome section of the retina of the eye of an owl can be brought out by using various ultra-violet wave-lengths (Fig. 1).

In addition to the low-power monochromat lenses which have been available for some years, achromatic systems made in fused quartz and lithium fluoride have been designed by Mr. Johnson at the Imperial College. These have extraordinarily small variations of focus with wave-length, so that it is possible to focus in visible light and photograph with the ultra-violet; and moreover it is possible to employ a range of wave-lengths for illumination, so that a mercury lamp with suitable filters can be used in place of the usual condensed spark and monochromator system.



$\lambda = 0{\cdot}45\mu$ (violet) × 340

$\lambda = 0{\cdot}362\mu$ (ultra-violet) × 400

$\lambda = 0{\cdot}275\mu$ (ultra-violet) × 400

Fig. 1.

SECTIONS OF OWL RETINA PHOTOGRAPHED IN VISIBLE AND ULTRA-VIOLET LIGHT. (B. K. JOHNSON) 8 MM. MONOCHROMAT. THE SPECIMEN IS UNSTAINED; NOTE THE DIFFERENTIATION OF THE STRUCTURE DUE TO THE EMPLOYMENT OF DIFFERING WAVE-LENGTHS.

We must mention the difficulties preventing the use of shorter and shorter wave-lengths to secure an indefinitely small resolving limit.

With the shorter wave-lengths: (1) both figure and polish of the surfaces must be increasingly perfect; (2) the homogeneity of the optical materials must be increasingly perfect; (3) air does not transmit radiation beyond $0{\cdot}18\mu$, and vacuum or nitrogen-filled instruments become necessary; (4) with still shorter wave-lengths, the usual refracting media become opaque; this requires reflecting instruments, *but* the difficulties in item (1) above then become more severe; errors in reflecting surfaces cause about four times the effect of equal errors in refracting surfaces; (5) for the same numerical aperture, the depth of focus of ultra-violet lenses becomes increasingly small.

The cumulative effect of such difficulties was enough to make it seem probable, a few years ago, that the limits of resolution represented by the ultra-violet immersion monochromats would never be greatly surpassed; we should remain unable to resolve points closer together than about $0{\cdot}1\mu$ or 10^{-5} cm. The discovery of X-ray diffraction by crystals, thirty years ago, mitigated this trouble by providing a means of examining the structure of crystal lattices and quasi-crystalline material. This was supplemented about 1927–28 by the discovery of electron diffraction. It had been known for many years that cathode rays could be deflected by electric and magnetic fields. Already in 1926 it had been shown by Busch that electron streams could be focused by axially symmetrical magnetic or electrostatic fields, much as light is focused by a lens, and the theories of de Broglie had introduced the idea that the motion of the electrons might be associated with a system of waves, which, however, are not to be confused with the electro-magnetic wave motion of light. Prof. G. P. Thomson's diffraction experiments permitted the calculation of the wave-length, which was found to agree with the relation

$$\lambda = 10^{-8}\sqrt{150/V},$$

where V is the potential difference (in volts) causing the electron velocity. Thus if the accelerating potential is 15,000 volts, the wave-length will be 10^{-9} cm. as compared with the $0{\cdot}5\times10^{-4}$ cm. for visible light, and about $0{\cdot}25\times10^{-4}$ cm. for the ultra-violet. At this stage it might have been clear that a powerful new technique of microscopy was possible. It was not, however, until 1932 and onwards that experiments in this direction were begun by Knoll and Ruska in Berlin.

Suppose that an electron is moving in an equipotential enclosure with uniform velocity v_1 and is incident on a bounding surface at an angle i_1. It escapes, through apertures, into a region with its bounding surface parallel to the first, where its velocity is i_2. Since the only acceleration it can experience in passing across the boundary layer is perpendicular to the surface, the component of the velocity parallel to the surface is unchanged, that is :

$$v_1 \sin i_1 = v_2 \sin i_2.$$

If we compare this with the law of refraction of light

$$n_1 \sin i_1 = n_2 \sin i_2,$$

we see at once that there is an analogy between the velocity of the particle and the refractive index (n) of a medium.

Now in traversing an axially symmetrical electrostatic field the electron experiences differences of velocity corresponding to the potential from point to point of its path. Thus it will traverse a path similar to that of a ray of light passing through a medium with axially symmetrical variations of refractive index. The crystalline lens of the human eye is an example of such a case in optics. Though the theory is more complicated than that of ordinary lenses, it can be shown that the image formation and its defects are subject to closely similar laws.

Electron optical focusing systems with electrostatic fields have been largely employed for a study of the thermionic emission of metallic and other surfaces, an image of the cathode being produced on the screen or plate. This is analogous to the microscopy of self-luminous objects. On the other hand, magnetic fields have offered the most direct means for the microscopy of biological specimens.

We copy the early steps in ultra-violet microscopy and use monochromatic radiation ; in this case an electron beam of extremely perfect homogeneity. Even so, transmission through the object and supporting film produces some disturbance of the homogeneity.

Analysis shows that though spherical aberration can be controlled to some degree, we cannot entirely remove it. Consequently we have to copy the earliest step in ordinary microscopy and employ a small stop at the objective, just as was done in Hooke's microscope. We now meet precisely the same difficulties as was the case in those days. We must cut down the aperture to remove the excessive effects of spherical aberration and secure sufficient contrast in the image, but we cannot proceed indefinitely in this because of the loss of intensity and the increasing effects of diffraction.

Suppose that rays passing through the object plane diverge at an angle δ with the axis and pass the objective at an axial distance y. A formula given independently by Parnum and von Ardenne expresses the resolving limit (*R.L.*) in the object plane due to the presence of electrons with a range of velocity potentials dV, considering axial chromatism only :

$$R.L. = y\frac{dV}{V}$$

If therefore $y = 0{\cdot}0025$ cm. and we take a value of dV/V which can be obtained without unduly expensive electrical apparatus (4×10^{-4}), we obtain $R.L. = 10^{-6}$ cm. The approximate focal distance of the objective when working at a high magnification may be about 5 mm. Hence the angle δ will be about 0·005 radians. We have every reason to believe that if the lens system could be free from aberrations, the resolving limit would be represented for some objects at least by the Abbe formula

$$R.L. = \frac{0{\cdot}5\,\lambda}{\delta} \text{ approximately.}$$

Taking the previously calculated value of λ: namely, 10^{-9} cm., we get $R.L. = 10^{-7}$ cm.

On the other hand, a formula has been calculated by Rebsch for the resolving limit set by spherical aberration (when minimized so far as possible). This gives :

$$R.L. = 0{\cdot}1\, f\delta^3$$

Thus $R.L. = 0{\cdot}625 \times 10^{-8}$ cm. in our case.

Considering the three limits above, it would appear that we might improve matters by increasing the homogeneity of the beam and increasing the aperture until the spherical aberration increases to a value comparable with the Abbe limit. There are, however, other considerations which do not appear to have been dealt with in any of the papers hitherto published abroad.

Every optician knows the importance of centring in an optical system ; in a telescope or microscope it is secured by the assembly of lathe-turned and centred parts, but in the electron microscope this cannot be so readily done, because the real symmetry required is that of the magnetic fields. Irregularities of the windings of the coils, variability of the air gaps between coil sheathings and pole pieces, lack of homogeneity of the material of the sheathing and the disturbing effect of the earth's magnetic field ; all these may be present to disturb the perfect symmetry of the arrangement.

If such irregularity is present, there may not be any part of the image which can be said to be truly axial in the optical sense, and consequently all the image points may be subject to lateral chromatism in addition to axial chromatism. The lateral chromatism is likely to produce a one-sided streaking of the image, and represents one of the chief difficulties in working with a cold cathode discharge. Better homogeneity can be secured by a hot cathode and filter circuits to eliminate ripple of voltage. Comparatively recently Bruche and Haagen have used electrostatic focusing, in which the variations of the focusing field potential follow those of the cathode; this should overcome 'chromatic' error.

The chief technical difficulties appear to have been largely overcome by Ruska and his colleagues at the Siemens Works laboratory, although full details of their methods are not yet available.

The objects have to be mounted on collodion films in a vacuum; though the resolving limit is very small, the extremely narrow pencils of rays render the depth of focus fairly large even in comparison with the optical case. This means that the electron optical method is capable of giving a sharp outline picture, even of objects which are of the same order of thickness as ordinary microscopic objects.

What are the chances of lowering the resolving limit drastically enough to render possible a fairly exact measurement of the diameter of the protein molecules?

The above calculations of spherical aberration related to lenses free from axially symmetrical space charges, but control of space charges (for example, we may instance the new technique of phase focusing) is now being better understood. It does not appear to be impossible that spherically corrected electron lenses may ultimately be produced. If so, the history of early microscopy may repeat itself and yet another world be opened up to vision.

THE MEASUREMENT OF ART

BY F. IAN G. RAWLINS,
NATIONAL GALLERY

IT is conceivable that art cannot be measured. Nevertheless, there have been many attempts to do so, and it is not a little remarkable that these efforts are characteristic of the age of the Greek philosophers in much the same way as they are being made now, alongside the rapid progress of theoretical physics.

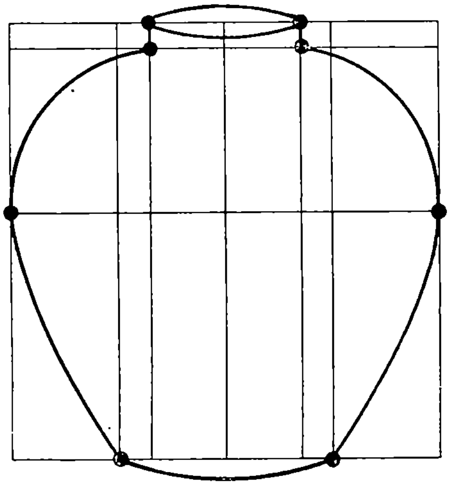
Whatever branch of art is considered, it has become clear that there are at least two categories of æsthetic experience, the formal and the connotative. The first relates to such properties as symmetry, balance, harmony, and so forth, the second to significance or meaning. Thus, a supreme picture will be perfectly composed in design; its function, however, will not be completely fulfilled until its intention (meaning) has exerted its maximum effect. This effect is probably unique. Evidently, the proper enjoyment of art depends upon some degree of formal and connotative training.

Is it feasible now to go farther, and to set up a system of art-metrics, such that personal predilections and judgments may be somewhat disciplined, without doing violence to their essentially intuitive nature? This article will discuss such a possibility in the light of some recent developments. The division of the whole subject into formal and connotative domains will be retained; but it is clear that 'transitional' cases cannot be eliminated, intractable as they may be. It is not difficult to guess which of the two classes of æsthetic experience has been found to be the more amenable to analysis; some writers have almost asserted that the connotative field is utterly unapproachable. This attitude seems doubly unfortunate, for not only does it discourage adventure (which nobody denies is hazardous; but is probably all the more attractive for that reason), but also it denies the possibility of synthesis between the two kinds of experience. The existence of this no-man's-land has been suspected for a long time; to explore it is very tempting.

FORMAL EXPERIENCE

The aim here is to produce an equation, capable of ready numerical solution, which will enable objects within a given category (for example, tiles, vases, decorative designs, melodies, poems) to be arranged in order of æsthetic value. It is important to notice that no attempt is made to compare the relative merits of things in different categories (for example, a vase with a poem). From what has already been said, it will be seen that the basis of such an 'æsthetic formula', as Birkhoff[1] has called it, is largely geometrical, or, rather, the euvalation of a number of severely restricted geometrical properties. These 'elements of order' may not always be positive; ambiguity seems likely to introduce a negative sensation into formal æsthetic experience. An example would be a rectangle which is nearly, but not quite, a square; another would be a grouping of figures just too haphazard to balance, and yet not free enough to be natural.

To express these formal factors, Birkhoff writes $M=O/C$, where M is the æsthetic measure, O is the order (symmetry, harmony), and C is the complexity of the object. This latter quantity is considered to bear a proportional relation to the preliminary effort of attention made by the beholder. Physically O and C are the observables, and from their ratio M is deduced.



T'ANG VASE. REPRODUCED FROM BIRKHOFF'S "AESTHETIC MEASURE", FIG. VIII OF PLATE XVII.

An example will make the method clear. The T'ang vase shown in the accompanying figure in outline is typical; such a two-dimensional representation may be called the 'symbol' of the vase. O is found in the following way: $O=H+V+HV+T$, where H is the number of independent quotients 1 : 1, 2 : 1, taken horizontally on the frame of reference (see figure). V represents the same taken vertically; HV refers to independent relations both horizontal and vertical, and T is the number of tangents defining certain characteristics of the 'symbol'. Further, the complexity C is the number of points, indicated by dots on the outline in the figure, upon which the eye would naturally rest in its attempt to follow the contour. For this vase we find $H=2$, $V=0$, $HV=1$, $T=0$. Therefore, 0 $(=H+V+HV+T)=3$, $C=8$, and hence $M=O/C=\frac{3}{8}=0{\cdot}37$.

The working has been very much abbreviated, but is perhaps sufficient to indicate the method, without embarking upon elaborate detail, irrelevant to the present discussion.

The point is this. The analysis, restricted and arbitrary as it appears, does enable a collection of vases to be arranged in order of (say) decreasing M; moreover, it is found that such a sequence corresponds reasonably with æsthetic judgment. It also seems to take some account of their functional appropriateness, which is interesting, since such a recognition is largely connotative. Modifications of the procedure are obviously needed for other classes of objects, but the general treatment is similar.

CONNOTATIVE EXPERIENCE

To approach this aspect of art measurement is far more difficult, and the results therefore are likely to be less convincing in themselves, and more slender in foundation. The whole outlook is far removed from that of 'safety first'. Nevertheless, an attempt has been made.[2] We recollect that the purpose now is a search for meaning and the possibility of assigning a value to it. This prompts the query: What kind of knowledge (or, perhaps, what science), incorporates an essentially integrative property of form with the basic element of significance? The Gestalt theory of psychology does this, and to such a theory it is natural to turn.

The vital pre-requisite is to obtain a functional relation, in the mathematical sense, between something that can be perceived (otherwise there would be no contact with formal experience) and some elemental property of the object in question, independent of the observer. It is here that the Gestalt concept may be what we need. Consider the doctrine of energy applied to a picture in the making. There is the creative energy of the artist E_c. Then there is the intrinsic energy E_i (at any stage) of the picture which he is painting, and finally there is the free energy E_f of the picture when it is finished, or, for that matter, at any moment of its evolution. Presumably—with certain limitations too complex for discussion here—the total energy of the whole system E is constant and equal to $E_c+E_i+E_f$ algebraically. For a great picture, sublimely conceived, and perfect in finish, E_f is numerically very small (theoretically, perhaps zero): E_c has supposedly decreased, but E_i may be very large. For the moment we are concerned with neither E_c nor with E_i. It is E_f which interests us, for it is a measure of our picture's (connotative) stability, of its power to give lasting satisfaction, in very truth, therefore, of its meaning. We look, then, for the condition E_f=a minimum.

In Gestalt theory, significance is connected with the 'psychological organization' ψ by the law of *prägnanz*, which states that such organization will always be as 'good' (that is, 'symmetrical', 'satisfying', 'stable', and so on) as the prevailing conditions allow. Thus, we are constrained to relate the free energy to the psychological organization, and to write the tentative equation $E_f=F\ (\psi)$.

That value of ψ corresponding to a minimum of E_f gives us the organization associated with connotative stability. This entity ψ clearly has a quasi-geometrical nature, which suggests a parallel with Birkhoff's 'order' O; in addition the function $E_f=F\ (\psi)$ contains implicitly the characteristics of a potential in physics. It will be noticed, moreover, that the observer is not directly concerned in this equation; in a sense, therefore, it is invariant in this respect.

The train of thought just followed has not resulted in establishing a calculus or test of significance in art; perhaps such an outcome is entirely beyond us. It has, however, suggested a connection between the energetics of an object of art (somewhat akin to a closed system in thermodynamics) and a quantity called the organization. From this interdependence some estimate of the effort involved in creation may be obtained, and consequently a glimpse of the cost to be faced in the conveyance of meaning. To repeat: it is not meaning itself which has been measured; it is the price of meaning to which a token value has been given. A sublime work of art, a statue by Michelangelo, for example, possesses vast intrinsic energy; its majesty, however, resides in its (connotative) changelessness—or low free energy—a reminder of the creative energy outpoured in its fashioning.

AN ATTEMPTED SYNTHESIS

We are left with the two relationships, the explicit equation $M=O/C$ (Birkhoff), and the function $E_f=F(\psi)$ (Gestalt). Examination of the complexity C suggests that it has the dimensions $[mt^{-2}]$ which must also be the dimensions of O, since the æsthetic measure M is a numeric. If now E_f is interpreted as a surface density of free energy (rather than free energy itself) this becomes of like dimensions, that is $[mt^{-2}]$. Since M is a measure of merit, it follows qualitatively that, for a given order, æsthetic value increases the lower the free energy density, in harmony with the Gestalt concept, which derives from totally distinct postulates.

Let us return in the end to the contemplation of a supreme work of art. We can, perhaps, determine its æsthetic measure; we can but dimly sense its free energy. Of one thing only can we be sure—of the strife inseparable from its creation.

---

[1] "Aesthetic Measure", by G. D. Birkhoff, Harvard University Press, 1933.

[2] "An Experimental Philosophy of Paintings", by F. Ian G. Rawlins, *Science Progress*, October 1939, pp. 263–276.

OBITUARY

Mrs. Tyndall

THE death of Mrs. Tyndall on August 19 removes one of the last links of the Royal Institution with the great era of Victorian science. Louisa Charlotte Hamilton, which was her maiden name, was born on August 3, 1845, and was the eldest of three daughters of Lord Claud Hamilton and Lady Hamilton. Her mother's maiden name was Elizabeth Emma Proby, and her only brother, Douglas James, who assumed the name of Proby in 1904, died in 1931.

Before her marriage, Mrs. Tyndall enjoyed the privilege of meeting in her father's house in London the great men and women—statesmen, writers, and leaders of thought—of a particularly interesting period of British history; with the further experience of residence and travel in Ireland and abroad, where her father held diplomatic appointments. At a time when science and research were studies pursued by relatively few, she became one of an earnest group of women of high social position who followed the lectures on scientific subjects provided by the Royal Institution. It was in the winter of 1860 that she was taken by her mother to Faraday's juvenile lectures at the Institution. Tyndall had then been professor of natural philosophy there since 1853, having been appointed to the post on the recommendation of Faraday, whom he succeeded as superintendent in 1867, but it was not until later that she made his acquaintance when travelling with her father in Switzerland. His tribute to Faraday's genius and loveable nature was paid in his book "Faraday as a Discoverer", first published in 1868—a year after Faraday's death. To the fifth edition, which appeared in 1894, Mrs. Tyndall added a note saying that the preface to it was written a few days before his death.

It was on February 29, 1876, that Miss Hamilton became the wife of Tyndall; and from that time she was, to quote her own words, "his companion in all things". She was a perfect hostess in the busy and intensely interesting years of residence at the Royal Institution, where the superintendent's apartments over the lecture theatre were their home. Here she received a warm welcome in the large circle of Tyndall's friends, which included the Rayleighs, Huxleys, Herschels, Lubbocks, Hookers, Tennysons, Pollocks, Herbert Spencer, and many others. In all Tyndall's investigations and activities, Mrs. Tyndall was his constant companion and an intelligent helper as recorder and amanuensis; in his hard-earned holidays the best of comrades, while ever watchful of his health and untiring in her efforts to find food suited to his weak digestion, which had troubled him from early years.

So early as 1857, Tyndall had paid a first visit to the Swiss Alps with his friend, T. H. Huxley, to make a holiday study of glacier ice. The mountains fascinated him, and from then onwards all his holidays were spent in Switzerland. Soon after their marriage, the Tyndalls built a cottage on Bel Alp, high above Brieg, in the Canton of Valais, and there they afterwards spent their summers. Some years ago, with the ready consent of the local authorities, she erected nearby a simple monument, consisting of a single massive stone, to her husband's memory.

In 1885, the Tyndalls bought about one hundred acres of land on the summit of Hindhead, in Surrey, then a wild heather-clad hilltop, where they built what Tyndall termed a "retreat for my old age". After Tyndall's retirement from the Royal Institution in 1887, most of their time was spent at Hindhead, and it was there that he, whose health had been failing for some years, during which his wife nursed him devotedly, died on December 4, 1893, as the result of an overdose of chloral accidentally administered by her.

The rest of Mrs. Tyndall's life was mainly devoted to the collection of material for Tyndall's biography, which they had jointly planned during his lifetime, and which she intended to write ; but the work was constantly interrupted by the claims of her family and of friends and dependents, and especially of her mother, Lady Claud Hamilton, who died after several years' illness at Hindhead in 1900. Though she lacked the qualifications to deal with Tyndall's scientific work, she contributed an admirable memoir on him to the "Dictionary of National Biography", but owing to her intense admiration for him and devotion to his memory, she was unwilling to entrust the work to anyone else, and various proposals and suggestions as to the choice of a biographer, which might have resulted in the production of the work in her lifetime, came to nothing.

A vast amount of material relating to Tyndall's life and work was collected by Mrs. Tyndall, with the valuable assistance of several friends, among whom Miss M. Dodd (Mrs. Lewin) may be specially mentioned, with the result that when Mrs. Tyndall's health broke down five years ago, the greater part of the preliminary work had been completed. Since then, what was still needed in the way of arrangement and sorting of the material has been put in hand by her nephew, Mr. Granville Proby, and a biography of Tyndall, for the publication of which she provided in her will, is in course of preparation. In addition to Tyndall's scientific papers, the material includes thousands of letters, among them being a large foreign correspondence with Helmholtz, Bunsen, Clausius, Pasteur, and many others.

It is fortunate that, by her devotion to her husband's memory, Mrs. Tyndall was able to preserve so much material relating to his original scientific work, as well as of his advocacy of the use of scientific thought in other fields of inquiry, and his influence in extending general interest in advance in natural knowledge during a very fertile period of development. The biography will be a valuable record of this period and a long-needed memorial to one who did so much to shape it. Two other tributes to Tyndall's memory are the gift by Mrs. Tyndall, some years ago, of a fund of £1,500, administered by the Royal Society for the purpose of encouraging and furthering research in matters relating to mining, and a fine valley at Hindhead, known as Tyndall's Wood, which has become the property of the nation through the National Trust.

WE regret to announce the following deaths :

The Duke of Bedford, K.G., K.B.E., F.R.S., formerly president of the Zoological Society of London, on August 27, aged eighty-two.

Dr. J. Burtt-Davy, formerly University demonstrator in forestry and lecturer in tropical forest botany in the Imperial Forestry Institute, Oxford, on August 20, aged seventy.

Prof. C. F. Jenkin, C.B.E., F.R.S., emeritus professor of engineering science in the University of Oxford, on August 23, aged seventy-four.

Sir Oliver Lodge, F.R.S., on August 22, aged eighty-nine.

NEWS AND VIEWS

Daniel Solander

THE June issue of the *Anglo-Swedish Review* contains an address recently delivered at the annual meeting of the Swedish Academy of Science on Dr. Daniel Charles Solander, F.R.S., the Swedish botanist, in whose honour the Academy's commemorative medal has been issued this year. Solander was born in the small town of Pitêa in the north of Sweden on May 13, 1735. At the age of twenty he entered the University of Uppsala, where he studied medicine and became one of the most gifted pupils of Linnæus, who sent him to London in 1766 to encourage the study of natural history in England. He soon came in contact with Mr. (afterwards Sir) Joseph Banks and was made an assistant in the British Museum Library in 1763. In 1768 he was engaged by Banks to accompany him on Captain Cook's voyage in the *Endeavour* to Tahiti, and in 1772 visited Iceland with Banks. The following year he was appointed keeper of printed books at the British Museum.

Solander was not the author of any independent work, but in 1756 he edited Linnæus's "Elementa Botannica", in 1766 he described the fossils in Brander's "Fossilia Hantoniensia", and in 1786 arranged and described the material in John Ellis's "National History of Zoophytes". In 1764 he was elected F.R.S. and in 1771 was made hon. D.C.L. at Oxford. His name has been commemorated in the genus Solandra and in an island in the Pacific Ocean near the south coast of New Zealand discovered by Captain Cook in 1770. He died at the early age of forty-six of apoplexy on May 16, 1782.

Dr. Félix Gerlier (1840–1914)

DR FÉLIX GERLIER, a distinguished Swiss physician, was born at Ferney-Voltaire in 1840, the son of a local practitioner. He qualified in Paris in

1866 with a thesis on death from cardiac concretions in diphtheria, and then set up in practice in his native town, where he remained until his death on September 6, 1914, except when he served as a medical officer in the French army during the Franco-Prussian War. He was for several years mayor of Ferney, where the high esteem in which he was held led to his being created a knight of the Legion of Honour. Gerlier is best known for his classical description of epidemic paralysing vertigo, to which his name has been given. His first account of the disease was given in 1886 before the Medical Society of Geneva, of which he was a corresponding member, and was published the next year in the *Revue médicale de la Suisse Romande*, his subsequent papers on this subject appearing in this journal in 1888 and 1891 and in the *Archives générales de médecine* in 1899. The disease has a very limited geographical distribution, being found only in the Pays de Gex on the Franco-Swiss frontier and in Japan, where it is called kubisagri and has been studied by Couchoud, who regards it as due to a small coccus. Outbreaks take place in May or June, reach their acme in the summer and come to an end in the autumn. The disease has been found in cats and fowls and appears to be causally connected with close contact with horses and cattle, although they do not contract the disease. The symptoms consist in sudden attacks of vertigo and generalized muscular weakness accompanied by diplopia and amaurosis, and lasting for about ten minutes. Nothing definite is known as to the pathology of the disease, and there is no specific treatment.

Antiquities from the Northumberland Collections

Two important and interesting specimens from the Egyptian and western Arabic collection of antiquities belonging to the Duke of Northumberland recently removed from Alnwick to be placed on loan in the British Museum have been described and figured by Mr. Sidney Smith (*Brit. Museum Quarterly*, 14, 2; 1940). Of these the first is an 'elegant vase' for cosmetics in the shape of a naked slave girl carrying a vase and walking on a pedestal. It was described many years ago by Samuel Birch, keeper of the Department of Egyptian Antiquities in the British Museum, in his catalogue of the collection. He did not, however, as Mr. Smith points out, fully appreciate the singular interest of the figure. Except for a wooden statuette in the Louvre, there is no other example of a similar treatment of movement of the body among such wooden figures. The material has been identified as a boxwood from the Lebanon, and while the Louvre male figure has been assigned to the Eighteenth Dynasty from its resemblance to Syrian figures depicted in the tombs, the figure of the girl is not likely to belong to the early part of the dynasty but is assigned to the reign of either Amenhotep III or Tutankhamen.

The second exhibit described is a cylinder seal of hematite of a shape common in the fifteenth century B.C. and later. Its singular importance and unique character lie in the fact the men and bird depicted on it lie outside the known categories of themes on cylinder seals, yet the seal itself and some elements are normal in Syria about the middle of the second millennium. The men wear light waist-belts and a short kilt flounced, which resembles, though it is not identical with, the Cretan wear for athletes. Mr. Smith suggests that it is not a sufficient explanation of the seal to say that it shows Cretan influence, but that it looks as if a Babylonian seal-cutter was actually depicting men in Syria who wore something like Cretan dress, and copied for this purpose such figures as the running men from foreign art. If this be accepted, this seal and the Egyptian figures throw an interesting sidelight on the spread and distribution of artistic activities and motifs in the world of the ancient East in the second millennium B.C.

The Royal Asiatic Society of Bengal

A RECENT reorganization in the administration and installation of the Royal Asiatic Society of Bengal, which is set out in detail in the recently issued annual report (Year Book for 1939, 6; 1940) has already borne fruit, more especially in a speeding-up of publications which had been allowed to fall in arrear. It is possibly to be attributed to the same quickened interest in the work of the Society that the exhibits shown at its annual meeting on February 5, 1940, attracted exceptional attention, notably in anthropology and archæology, subjects upon which as studied in India criticism has recently been directed with no little vigour from more quarters than one. Of the ethnographical exhibits the most striking was a small collection of the wooden effigies erected in memory of the dead by the Red Kaffirs of the Hindu Kush. These effigies came from the village of Rambur and were collected by members of the Zoological Survey of India in 1929. One represented a man riding a horse and the other a woman wearing the characteristic horned head-dress of the Red Kaffir women. It may be of interest to note that it has been suggested that these figures may have some relationship to certain of the well-known Easter Island figures, of which the origin and purpose have been the subject of much discussion.

Another exhibit of considerable interest was a collection of human skeletal remains recently excavated by the Archæological Department of Gwalior State on a Mauryan site at Kumhar Tekri near Ujjain. With the exception of those found by Sir John Marshall at Taxilla, these are the only human skeletal remains of the Historical Period, which have as yet been brought to light by archæological excavation. It is noteworthy that the great development of the posterior parts of the skull characteristic of the big-brained races of the chalcolithic Indus Valley civilization is not found in the skulls of the Historic Period.

New Regulations for Pharmaceutical Examinations

NEW regulations governing the conditions prerequisite to pharmaceutical qualifications have been made by the Council of the Pharmaceutical Society. The work of revision began in 1936 and the sub-committee which was appointed for the purpose was assisted in its deliberations by representatives of the

Ministry of Health and the Department of Health for Scotland and by the external registrar of the University of London. The revised regulations, which affect both the Society's examinations and the curriculum of study, will come into operation in October, subject to the approval of the Privy Council. The syllabuses for the Preliminary Scientific Examination, to be known in future as the 'Intermediate Examination', have been simplified to some extent and the changes are in favour of candidates rather than otherwise; for example, organic chemistry will not be taken at this stage in future. The physiology of heterotrophic plants has been deleted from the botany syllabus and saprophytism and parasitism have been added. The wording of the zoology syllabus has been modified with the object of limiting the knowledge which the candidate should possess of histology and otherwise of indicating that attention should be directed mainly to types and not to groups to which the types belong. More important, however, is the provision that the Council of the Pharmaceutical Society may require that the Intermediate Examination shall be passed before the student commences his practical training in a pharmacy or a hospital; this provision is wisely conceived, for the present high percentage of failures clearly suggests that many candidates would be well advised to choose some career other than pharmacy.

With regard to the Qualifying Examination, there has been some unloading of the syllabuses, but this does not appear to reduce the general standard of requirements. In pharmaceutical chemistry the candidate's knowledge of tests for purity and of chemical assays will in future be limited to those of the British Pharmacopœia and, in pharmaceutics, the reference in the syllabus to the biological standards of galenical preparations has been deleted, as the principles underlying these subjects are more appropriately treated in physiology and pharmaceutical chemistry respectively. The changes affecting the Pharmaceutical Chemist's Examination include, in the pharmaceutical chemistry syllabus, the substitution of "adrenaline, thyroxine, vitamins A, B_1 and B_2, C and D" for the crystallizable hormones and vitamins and, in the pharmaceutics syllabus, the addition of the factors involved in transferring small-scale pharmaceutical operations to a large scale. The preparation of bacterial vaccines has been deleted, and disinfectants and the factors governing their efficiency have been added to the syllabus. Another addition is a knowledge of the physiological properties of vitamins. In the requirements for this higher examination, the object of the changes would appear to be directed to an adjustment to more recent developments in sciences allied to pharmacy.

British Birds in 1939

A NUMBER of local societies have recently issued their field records of bird-life in 1939. The London Natural History Society's Bird Report for 1939, issued separately from the *London Naturalist* for the fourth year, covers bird-life within twenty miles of St. Paul's Cathedral and notes more than 160 different species, including such uncommon visitors as the firecrest, great grey shrike, purple sandpiper and Iceland gull, a summary of the arrival dates of migrants for eight years and special accounts of the status of the goldfinch, stock-dove, sandpiper and redshank. The Merseyside Naturalists' Association's 1939 notes from Liverpool (*Ibis*, July) add the Kentish plover to the Lancashire list and the roseate tern to the Cheshire list, in addition to noting such uncommon visitors as the red-necked grebe, black redstart, velvet scoter and a mid-winter record of the little stint, as well as extensions of the nesting range of tufted duck, pochard and herring-gull.

In the home counties, the Oxford Ornithological Society notes the blue-headed wagtail at Slough Sewage Farm, Bucks, in May, June and July, as well as visits of grey plover, turnstone and knot, while in East Anglia, the Norfolk and Norwich Naturalists' Society Bird Report mentions two pairs of marsh-harriers at Hickling and Horsey but only one nest known to rear young, no Montagu's harriers and only about four pairs of bearded tits, a whiskered tern at Hitchling in June and a sight record of the Mediterranean Black Headed Gull in October. A pair of roseate terns nested at Blakeney and dunlin again at Clay, but the latter apparently not rearing young. The Cambridge Bird Club notes bittern, Montagu's harriers and black-necked grebes on Burwell Fen, but not nesting, nor was the black redstart again found nesting in its 1938 haunt. The Yorkshire Naturalists' Union report (*Naturalist*, 1940, pp. 7–18) notes the siskin nesting at Goathland, pintail at Skipworth, and the crossbill at Thornton Dale; goshawk, water-pipit, an immature white-tailed eagle, ospreys and red-legged partridge were uncommon records. The nesting of the arctic tern at Spurn is believed to be a county record.

Public Health Progress in India

THE July issue of the *Asiatic Review* contains an interesting article by Sir Alexander Russell, formerly medical officer of health and professor of hygiene and bacteriology at Madras, on public health progress in India during the last forty years. Since 1911, research work under the auspices of the Indian Research Fund Association has been chiefly connected with India's public health problems and considerable achievements have been recorded, especially as regards plague, cholera, malaria, kala-azar and nutrition, while investigations on the indigenous drugs of India have done much to determine their therapeutic action. The Research Association has also supplied means for the training in research of a large number of Indian graduates of science and medicine. An All-India League was formed in 1921 to promote maternity and child-welfare throughout the country. In 1930 it became the Maternity and Child Welfare Bureau, and now in most provinces the work is carried on either through the official health departments or by voluntary organizations.

The Institute of Hygiene and Public Health provides a course of instruction and a diploma in maternity and child-welfare, while half a dozen small provincial schools serve for the education of health visitors. Since 1929, considerable advance has been made in a campaign against tuberculosis. As regards leprosy, for many years the work was confined to the provision of a number of asylums for lepers, but about fifteen years ago scientific research showed that early cases were amenable to treatment, and in 1934 the British Empire Leprosy Relief Association was founded. In the following year an Indian Council for the Association was inaugurated, and research work was intensified, especially by the Calcutta School of Tropical Medicine.

Disease Among Natives of Alaska

IN a paper read before the Section on Medical History of the College of Physicians of Philadelphia (*Trans. and Stud. Coll. Phys. Philadelphia*, 4, Ser. 8, 27 ; 1940) Dr. Joseph D. Aronson, associate professor of bacteriology in the University of Pennsylvania, remarks that though little is known of the occurrence of disease among the natives of Alaska prior to its discovery by the Russian explorer Khirikoff in 1741, the early reports and records indicate that diseases due to food deficiencies existed and that smallpox, syphilis and tuberculosis were unknown and were probably introduced by the white man. Smallpox, which was probably introduced by the Spaniards, caused more suffering and loss of life than any of the other diseases. The mortality was particularly high among adults and considerably less among children. It soon became clear that in parts where vaccination was employed the disease was brought under control and the mortality fell to 10 per cent or less, whereas in areas where the natives refused to be vaccinated the mortality ranged from 40 to 60 per cent. Syphilis was brought into the country by hunters, traders, and especially sailors, and became widespread. There is no record of tuberculosis either in its pulmonary or extrapulmonary form such as lupus or involvement of the bones or joints, until 1770 or twenty-nine years after the discovery of Alaska. Afterwards it spread rapidly, though it did not reach the epidemic proportions of smallpox.

The Illegitimate Child

IN a review of this subject in the July issue of the *Quarterly Review*, Mr. Claud Mullins, the well-known Metropolitan police magistrate, remarks that illegitimacy is not only a problem in itself but is also a big contributing factor in prostitution, abortion and crime. He points out that the absence of a father from the beginning of the life of the illegitimate child must have a big effect, as it is the father's function to implant in the child impulses which produce law-abiding citizens. Only too frequently the illegitimate child is a rebel not only against the conventions of society but also against criminal laws. Sometimes the dangers of illegitimacy are minimized by the child's early adoption into a normal and healthy home, but most psychologists agree that even with adoption there may be a trauma in the child's unconscious, and this trauma may result in a later hostility to society. Mr. Mullins suggests that there should be a new bastardy law in which the interests of the child should be uppermost, and that regular maintenance should permit decent arrangements to be made for its upbringing and education. In conclusion he recommends the substitution of the words "natural child" for "bastard", and "child maintenance" or "child paternity proceedings" for "bastardy proceedings".

Treatment of Juvenile Delinquents

IN his inaugural thesis (*Thèse de Paris*, No. 1105 ; 1939), Dr. H. Pitoux, who records five illustrative cases, states that of 98 inmates of the Fresnes prison under thirty years of age, 61 had committed their first offence before the age of twenty-one. He recommends that in order to enable a young offender to play a respectable part in society he should undergo a medico-psychological examination, and a careful inquiry be made into his previous social environment. He should then be classified and sent to a centre suitable for his psychical and occupational level. Institutions with a staff specially trained to give the young offender an intellectual, moral and occupational education are needed to enable him to return to society. At the present time only the first part of this programme, namely, the scientific and medico-psychological, has been realized in France, but as regards education much still remains to be done.

Bibliographical and Intelligence Services

THE *Proceedings of the British Society for International Bibliography*, 1, Part 1–3 (1939) include a paper by J. E. Wright on the special library and information bureau established in connexion with the Post Office Engineering Research Station at Dollis Hill ; special reference is made to the use of the universal decimal system of classification in the indexing of literature and information relevant to the work of the Department. Dr. S. C. Bradford contributes a note on the co-ordination of documentation, in which the limitations of abstracting periodicals are indicated, and the lack of co-ordination between the abstracting services leading to incompleteness and inconvenience is criticized. Dr. Bradford again argues that abstracting should be organized from the point of view of science as a whole. The information service of the Imperial Bureau of Horticulture and Plantation Crops is described by D. Akenhead. In addition to *Horticultural Abstracts*, the Bureau has issued twelve technical communications and five occasional papers, one of the latter being an annotated bibliography on the biter pit of apples, and another the translation of conclusions reached by a Russian author on the manuring of fruit trees. Primarily, the information service is for research workers in the Empire, but inquiries from private individuals or from foreign research workers are often handled.

The organization of an industrial intelligence service in relation to documentation is discussed by S. G. Barker, who argues that industry requires a co-ordinating agency for the dissemination of information regarding current work, both published and unpublished. It also requires, he considers, historical bibliographies of failures and successes and historical records leading up to and subsequent to them, as well as an intelligent observation of potentialities in regard to the future. These must be expressed to the business man and technologist in brief terse language, so that on straightforward reading he will readily grasp the essentials and be able to indicate to his subordinates and others what he requires in regard to detail. To do this effectively, co-operation, co-ordination and collaboration with other industrial information sources are essential, and this is the organization we seek.

Books to Read at College

THE Trinity College Bulletin, edited by Prof. H. T. Costello, which comes to us from Hartford, Connecticut, supplies a "List of Books for a College Student's Reading". This, first published in 1925, has now reached a third, revised edition, and deserves to be popular. The aim of the pamphlet is "to bring the best students and the best books together", helping them to avoid waste of time on inferior stuff. This is an excellent idea in view of the present over-crowded jungle of literature, the reduction of which by the stress of the War will, we hope, be permanent. The general reading course before us is well arranged. The List is divided into ten sections, and students are expected to read and write on something in eight of them. "Reading in the greater classics is likely to get special grade credit." This is as it should be. Early specialization pays to-day and interferes with that versatility which belongs to a liberal education. No censorship of ideas is attempted in the lists, and "books that may shock or annoy" are included. The short descriptions added to each item are expert and helpful.

Meteorites in the Indian Museum

A CATALOGUE of meteorites, with special reference to Indian falls and finds and to specimens in the Indian Museum, Calcutta, has been compiled by A. L. Coulson and published as Memoir 75 of the Geological Survey of India, 1940. An order of the Government of India lays down that all meteorites falling in British India are the property of the Government of India and as such should normally find a place in the Indian Museum under the care of the Geological Survey of India. Every effort is made by the Survey to obtain new falls, and these are carefully studied and the results published in the Records of the Survey.

The first catalogue of the collection was prepared by Thomas Oldham in 1864 and gave particulars of 21 stones and 26 irons. By 1914, when Coggin Brown's catalogue (1916) was compiled, the collection had grown to a total of 379, though some of the specimens included in this total have since been found to be identical, due to better knowledge of the various synonyms that have been used in the past. Recently there has been active exchange of meteorites with various British and foreign institutions and on August 1, 1939, the collection included 149 irons and 319 stones, a total of 468 falls and finds. The present catalogue deals primarily with Indian falls and finds, but also attempts to include all meteorites, whatever their locality. References to the most important literature dealing with Indian meteorites and a short résumé of the circumstances of fall or find has been given in every case. Other chapters deal with classification, dates of fall or find and geographical distribution.

A New Direction Indicator for an Aeroplane

ACCORDING to Science Service, Dr. David Luck has described before the U.S. Institute of Radio Engineers a new form of radio beacon for aeroplanes which has been developed after four years research under his supervision at the laboratory at Central Airport, Camden, N.J. It is called the omnidirectional radio-range beacon, and operates with ultra-high-frequency oscillations to reduce the effect of atmospherics to a minimum. Radio-beacons have been in use for several years, but they serve only to confine the pilot to a definite course. Some air lines have used in addition direction finders to show the direction of the transmitting station from an aeroplane, but these are not satisfactory when using ultra-high-frequencies owing to atmospherics.

Dr. Luck described the operation of the new device as follows. When the pilot has to fly around a portion of his course affected by bad weather, he can always 'see' the direction of the radio-station at a glance. If he wants to fly straight into or out from the beacon, he has only to hold the mark steady, at that course, against a scale on the instrument face. The operation of this indicator may be compared to that of a lighthouse sending out two kinds of light, one a beam which sweeps around steadily and the other a flash sent out in all directions the moment the beam points north. The interval is timed from the flash until the beam sweeps over the observer, and then the required direction from the lighthouse is found. In the new radio device, the radio-lighthouse is on the ground and the indicating instrument on the plane automatically times the flash and beam. All this is done electrically, and the lighthouse beam sweeps round sixty times each second.

Recent Advances in Electroplating

ACCORDING to the *Electrical Times* of August 15, the electroplating of chromium is finding a wide application for purposes other than superficial polish and protection. Recently a German technical paper published an account of the utilization of chromium plating for use with steel cutting tools and bearings. A cheaper grade of steel or even common iron may be employed. The working edge is then plated with chromium, which gives it a hardness comparable to that of diamond. The cutting edge may then be ground, for the chromium may be applied in any thickness, and the tool has all the best features of the hardest and most expensive high-grade steel, its life is multiplied by two or even ten, it wears away far more slowly, and will go through most hard metals as if they were cheese. Bearing journals left rather too small as turned out by the lathe may be thickly coated and then turned up to the increased diameter required, thus also obtaining a skin which lasts a very long time. Worn-down tools, bearings, bushes, gauges, valves, and drills can be rendered better than they were when new.

Similar researches have been made with regard to nickel. All buffing and polishing can now be avoided by using a brightening agent in the electrolyte for plating with this metal. The surface can be taken straight out of the bath directly with all the lustre obtainable by polishing, buffing and tumbling. As these processes involve more work than the electroplating itself, the great advantages of the new method are obvious. Other metals, including chromium, are now the subject of research, and it appears more than probable that a high polish in chromium will shortly be obtainable in the same way. Zinc, for example, is already being successfully applied with a high polish on emerging from the bath.

Verifying Telephone Subscribers' Numbers

To avoid the incorrect recording of callers' numbers in a trunk exchange associated with an automatic telephone area, various expedients have been adopted, including the reversion of a certain percentage of originating calls to the use of an audible tone. The supersonic signal method is described in a paper by W. K. Brasher and B. P. Moss (*J. Inst. Elect. Eng.*, July). It was evolved for Palestine, a country in which the use of a number of languages made the problem more acute. It is usual to check a certain number of demand calls either by establishing a second connexion to the subscriber's line, independent of the first, or by 'reverting' the call, that is, recording the particulars of the required number and informing the caller that he will be rung. Both methods lead to delays. Messrs. Brasher and Moss give a full description with diagrams of the method, which is being evolved in Palestine and is now being installed. Demand positions are served by a 20 kc./sec. oscillator, the output of which can be connected to the operator's telephone circuit of each position. When the demand operator has received the particulars of the wanted and calling subscribers, she passes the call to the distant exchange and moves a dialling plug suitably. The basic principle of the use of a supersonic signal in an automatic telephone exchange has been proved by test to be a practical scheme, no disturbing effect on other circuits having been noticed in a 5,000-line exchange.

The Night Sky in September

THE moon is new on September 2, whilst full moon (the harvest moon) occurs on September 16. On September 20 at 21h. and 23h. U.T. respectively, the moon is in conjunction with Saturn and with Jupiter. Saturn, to which the moon makes the closer approach, may be rather overpowered by the moon's glare. On September 28, a lunar conjunction occurs with Venus. On September 22, an occultation (reappearance) of the 1st magnitude star α Tauri (Aldebaran) may be observed at the moon's dark limb. At Greenwich the reappearance of Aldebaran, then only 9° above the horizon, is due at about 22h. 3m.; at Edinburgh, where the altitude is more favourable, the time is 22h. 16m., at position angle 215° from the moon's north point. Jupiter and Saturn continue this month as a notable pair of bright planets to be seen throughout the night. On September 16, Saturn souths at 3h. 11m. and Jupiter at 3h. 14m. (add 1 hour to obtain Summer Time). Close groupings of Jupiter's four inner satellites may be seen at 1h. on September 8, 9, 16, 18, 25 and 26. Venus, unmistakable in its brilliancy, also continues as the bright and morning star rising between 1h. 12m. (September 1) to 1h. 50m. (September 30). On the former date, Venus is about midway between Procyon and Castor and Pollux and by the end of the month has moved to a position preceding Regulus. The darkening evenings of September (the autumnal equinox is on September 23) gives unrivalled aspects, when the moon is absent, of the Milky Way near the meridian. The main features of this half of the great stellar structure are easily recognized—the great rift or bifurcation commencing in Cygnus and extending along the galactic equator: the brighter eastern stream with its various star clouds passing southwards through Aquila, Scutum, Sagittarius to Scorpio, where it is partially united with the broken western stream. More than 100 years ago, Sir John Herschel at the Cape, "rummaging the recesses" of Scorpio, found it full of beautiful globular clusters. It was somewhere here that the elder Herschel found the 'hole' in the heavens, which modern astronomers now recognize as one of the numerous dark nebulæ found in the Milky Way. The Pleiades rise in the late evening as the precursor of winter nights and of brilliant stars in their well-known constellations.

Announcements

DR. PAUL C. MANGELSDORF, vice-director of the Texas Agricultural Experiment Station, has been appointed professor of botany in Harvard University and assistant director of the Botanical Museum.

DR. WILLIAM CRAMER, British delegate to the International Cancer Congress at Atlantic City in September 1939 and for more than twenty-five years a member of the Imperial Cancer Research Fund, London, has joined the staff of the Barnard Free Skin and Cancer Hospital in St. Louis.

A FURTHER modification in the terms on which enemy aliens can be released from internment was announced by Sir John Anderson in the House of Commons on August 23. In the White Paper setting out the conditions of release, scientific workers and others with academic qualifications were to be granted release if national work in their special fields was available for them. This qualification is now to be removed, on the recommendation of the Asquith Committee, which pointed out that "the benefits of science and learning were often indirect rather than direct".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Reversibility of the Denaturation of Silk Fibroin

SILK, as it occurs in the silk-glands of the silkworm (*Bombyx mori*), consists of two distinct protein systems, and, during the spinning by the worm of the double filament which serves as a building material for the cocoon, these two systems are forced through small orifices in a manner such that they respectively produce a central core or medulla of fibrous material and an outer layer or cortex of gum-like substance. The cortical protein material (sericin) is readily dispersed by hot solutions of soap or mild alkali, while the protein material (fibroin) forming the core of the filament is insoluble in water and is resistant to relatively strong chemical reagents; it is these properties of the extruded filament that partly account for its use as a textile fibre.

The nature of fibroin present in the silk-gland has been examined principally by Foà[1], Hirazuka[2], and Ongaro[3]. These workers found that the protein material obtained directly from the isolated silk glands is readily dispersed in water but equally readily coagulated by shaking, addition of acid, etc. The coagulation by mechanical action apparently occurs during the passage of the secretion from the worm to the outside air. The coagulation of silk fibroin is considered by Ongaro to be irreversible, and this conclusion has not been contradicted by any experimental work up to the present time. Harris and Johnson[4] have obtained water-soluble preparations of fibroin by dissolution in concentrated salt solutions and subsequent dialysis, but these workers conclude that the preparation is one of chemically degraded fibroin.

During an investigation of the solubility of fibroin in various solvents, we found that solutions of fibroin in cupriethylenediamine reagent, neutralized by acetic acid to *p*H 7·5 approximately and treated with solid sodium chloride to about two thirds saturation, yielded a mucilaginous precipitate readily soluble in water. The aqueous solutions of fibroin thus obtained behave similarly to those obtained directly from the silk-gland by Ongaro. Thus coagulation occurs extremely readily on mechanical agitation or addition of dilute acid. An aqueous solution of concentration 2·2 per cent gave an optical rotation of $[\alpha]^{20}_{D}$–42·7°; Ongaro found $[\alpha]^{24}$–39°. It would therefore appear that the coagulation of fibroin can be considered as a process of denaturation and that the denaturation is reversible.

The reversion of heat denaturation in proteins has been accomplished to some extent by Michaelis and Rona[5], Spiegel-Adolf[6] and Wilhelm[7], while the conversion of fully denatured hæmoglobin into a water-soluble form to the extent of 80 per cent has been demonstrated by Anson and Mirsky[8]. The present method of renaturation is of interest owing to the well-defined conditions under which the reversion is achieved. Attempts to apply the method to heat-coagulated ovalbumin have so far proved unsuccessful.

Examination of the products afforded by the renaturation of fibroin of various origins indicates that the fibroin of commercial raw silk is heterogeneous in composition.

A detailed description of the above experiments will appear elsewhere in due course.

C. J. CADWALLADER.
F. O. HOWITT.
S. G. SMITH.

British Cotton Industry
Research Association (Silk Section),
Shirley Institute,
Didsbury, Manchester.
August 8.

[1] *Z. Chem. Ind. Kolloide*, **10**, 7–12 (1912).

[2] *Bull. Inter. Inst. Agric.*, **10**, 454 (1909).

[3] *Giorn. Chim. Ind. Appl.*, **15**, 506–510 (1933).

[4] *Ind. Eng. Chem.*, **22**, 965–967 (1930).

[5] *Biochem. Z.*, **29**, 294 (1910).

[6] *Biochem. Z.*, **170**, 126 (1926).

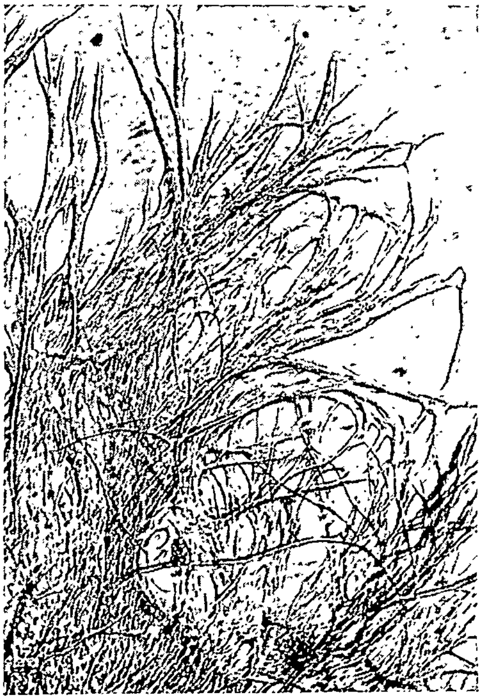
[7] *Koll. Z.*, **48**, 217 (1929).

[8] *J. Gen. Physiol.*, **13**, 121, 133, 477 (1929–30).

Architecture of Colonies of a Pure Strain of Fibroblastic Sarcomatous Cells derived from a Dibenzanthracene Mouse Tumour

DURING the *in vitro* cultivation of a pure strain of fibroblastic sarcomatous cells derived from a spindle cell sarcoma originally induced by 1 : 2 : 5 : 6-dibenzanthracene in mice[1] a special architecture of the colonies of these sarcomatous cells has been noted. When grown in Carrel flasks in a hen plasma coagulum and fed with either Heparin hen plasma[2] or a hen serum–chick embryo juice–Tyrode mixture, in which the embryo juice concentration is kept low, the cells regularly show a tendency to grow out in close association with one another, and to form ribbon-like strands or even broad sheets which resemble very much the epithelial type of growth *in vitro*. These ribbons frequently arborize and their branches often join up with one another, forming loops and bridges enclosing the coagulum, as shown in the accompanying illustration. The sheet-like growth is found especially at the interface coagulum-glass, whereas the cell ribbons occur also within the clot. This architecture seems to be very characteristic, and has been maintained through frequent passages. It permits the diagnosis of such a sarcomatous colony with the naked eye, being vastly different from the architecture of normal fibroblast colonies; aided by the more highly refractive cytoplasm of the tumour cells it brings the whole colony much more into relief against the background of the coagulum so that, even for the naked eye or under low power, the entire edge of the colony is sharply and clearly defined.

These sarcomatous cells scarcely liquefy the hen plasma coagulum. If, however, the culture is fed with embryo juice instead of the above treatment the cells grow out in a more scattered way, forming long chains of cells arranged in what can aptly be described as 'head-tail' position, the individual cell having a very definite spindle shape. It is known that liquefaction of the clot is aided by the enzymes present in embryo juice. It is therefore suggested that the characteristic colony architecture described above is related to the inability of the sarcomatous cells to liquefy the coagulum, the individual cell, unless aided by embryo juice, being unable to penetrate the coagulum to any extent, but when joined with fellow cells to form a ribbon or a sheet, will do so at a relatively slow rate. This architecture does not seem to have been commented on by other workers who used similar culture material[3,4,5]. But Earle[6] in a paper dealing with strip-shaped explants gives a photograph of a methylcholanthrene sarcoma culture the growth zone of which bears some resemblance to the ones described here.



PART OF LIVING SARCOMA CULTURE (*Fl* 9869 *c*) AFTER 163 DAYS *in vitro*; 32 DAYS AFTER LAST TRANSFER (× 55).

In the light of the difficulties which have been experienced by other workers,[4,5] in maintaining such sarcoma cultures over long periods, it is worth noting that the cell strain on which the above observations were first made was, in 1937, carried on *in vitro* for 131 days. The observations were confirmed in a new series of cultures which were started in January 1940 from the same tumour strain which was then in the 129th animal passage, its histological features being unchanged. These cultures, again of a pure 'fibroblastic' type, have now been carried on for 215 days so far, without impaired vitality. At intervals (after 134 and 181 days *in vitro*) some cultures were inoculated into mice (a single culture or part of such into each individuum), in some of which the original sarcoma was reproduced, that is to say, that in spite of the complete heterogenous medium in which the cells had lived and grown, they have preserved the property of forming a spindle cell sarcoma in mice.

Details of these experiments will be given elsewhere.

I wish to thank Dr. Woodhouse for supplying the tumour material. Thanks are also due to the Birmingham Branch of the British Empire Cancer Campaign for a grant which in part supported this work.

FRITZ JACOBY.

Department of Physiology and
Cancer Laboratories,
Medical School,
Birmingham, 15.
August 2.

[1] Stuart McDonald, Jr., and Woodhouse, D. L., *J. Path. Bact.*, **47**, 615 (1938).

[2] Fischer, A., and Parker, R. C., *Arch. exp. Zellf.*, **8**, 325 (1929).

[3] Doljanski, L., and Halberstaedter, L., *Amer. J. Cancer*, **29**, 285 (1937).

[4] Lewis, W. H., *Arch. exp. Zellf.*, **23**, 8 (1939).

[5] Ludford, R. J., *Brit. Med. J.*, 201 (1940).

[6] Earle, W. R., *Arch. Path.*, **27**, 88 (1939).

Cultivation of the Agent of Fowl Leukosis *in vitro*

THE following is a brief account of the cultivation of the causative agent of fowl leukosis (hæmacytoblastosis strain *T*1, Engelbreth-Holm) in the presence of normal cells proliferating *in vitro*.

Experiments were conducted as follows:

(*a*) Bone-marrow and fragments of heart muscles of chick embryos or of adult fowls were cultivated separately in plasma of leukotic fowls diluted with Tyrode 1 : 2. Before being used, the plasma was freed from cell elements by thorough centrifugation. Cultivation was carried out in flasks according to the standard method of Carrel. The cultures were washed and fed every third day with normal plasma (method Parker-Fischer). After 2, 3 and 4 weeks cultivation, flask cultures as well as control flasks, containing the same medium as the experimental flasks, but without any tissue, were inoculated into young fowls. Inoculation of flask tissue cultures resulted in typical leukosis. Of 7 cultures inoculated after 2 weeks cultivation, 4 were positive; of 3 three-week-old cultures, 2 proved positive; of 2 four-week-old cultures, 1 was positive. Inoculations with the control flask material always gave negative results. Leukotic agent survives *in vitro* in the presence of fibroblast cultures as well as in the presence of bone-marrow cells. Half the above experiments were carried out with bone-marrow cultures, and half with fibroblast colonies originating from cardiac muscle. The proportion of takes was approximately equal in both cases. Although the above experiments demonstrate beyond doubt the possibility of survival of agent in the presence of proliferating normal cells, we undertook further experiments because of the irregularity of the above results.

(*b*) Colonies of fibroblasts derived from normal heart were planted in Carrel flasks after having been bathed for one hour in cell-free ultrafiltrates (Berkefeld filter *N*) of heart and spleen extracts of leukotic fowl. Normal chicken plasma diluted with ultrafiltrates in proportion 1 : 2 was used as culture medium. Cultures were washed and fed with normal plasma. Altogether, four experiments were carried out, including a total of eight flasks ; the content of each flask was inoculated into two chicks. The fluid medium was injected intravenously, the solid material intramuscularly. Tissue-free control flasks were inoculated at the same time and in the same way. Of four cultures inoculated after two weeks cultivation and four cultures inoculated after four to five weeks cultivation all proved positive. Of sixteen chicks inoculated, fifteen died of leukosis. The fowls died twelve to twenty days after inoculation. Inoculations with the control flask material always gave negative results.

In further experiments, original cultures were transferred into fresh medium after thirty days cultivation. Up to date we have succeeded in maintaining such cell colonies for 86 days *in vitro*. Passages were made every second week. Cultures of first, second, third and fourth passage, that is, after 6, 8, 10 and 12 weeks cultivation, were each injected into two chicks. The washing fluid of these cultures, after passing through an ultrafilter, was inoculated at the same time as the cultures on two other chicks. Inoculations (into a total of eighteen fowls) gave positive results in all cases.

Our experiments show that under suitable conditions it is possible to cultivate leukotic agent in the presence of cultures of normal fibroblasts as well as in cultures of bone-marrow.

The fact that the agent which has the power to cause continuous multiplication of primitive blood cells in the body needs only the presence of non-specific mesenchyme cells for its reproduction *in vitro* need occasion no surprise in the light of the previous experiments with cultures of leukotic tissues. Contrary to Furth and Breedis[1], who were led by their experiments on cultivation of leukotic fowl tissues to conclude that "oncogenic viruses multiply *in vitro* only in the presence of cells on which they confer neoplastic properties", we were recently able to show in studies carried out on leukotic tissue cultures[2] that there is no relation between the infectivity of the culture and its cellular composition. Blood cell cultures and cultures of bone-marrow which, in the course of passages, are transformed into pure fibroblast colonies were in our experiments as pathogenic as blood and bone-marrow cultures in the earliest stages when they still contain numerous primitive blood cells. Furthermore, in confirmation of Ruffilli's[3] results, we proved that the cultures of myocardium of a leukotic fowl which we cultivated through 47 passages during a period of six months, and which already in the first passages are practically free of any round cells, retained their infectivity throughout.

Experiments with cultures of tissues from leukotic fowls did not, in our opinion, furnish sufficient proof that leukotic agent is capable of surviving and multiplying in the presence of non-specific mesenchyme cells because the possibility, however slight, that some primitive blood cells from the original leukotic tissues might survive in cultures could not be absolutely excluded. The experiments reported here furnish decisive proof of the fact that the agent producing leukosis in the fowls does not require the presence of primitive blood cells for its cultivation *in vitro* ; leukotic agent can be cultivated in the presence of common fibroblasts just like numerous non-carcinogenic viruses.

Details of our work will shortly appear elsewhere.

These investigations have been supported by a grant from the Lady Tata Memorial Trust.

L. DOLJANSKI.
M. PIKOVSKI.

Dept. of Experimental Pathology,
Hebrew University,
Jerusalem.
July 14.

---

[1] Furth, J., and Breedis, C., *Arch. Path.*, **24**, 281 (1937).

[2] Doljanski, L., and Pikovski, M.: "Studies on Cultures of Blood Cells, Bone-marrow and Myocardium from Leukotic Fowl *in vitro* (in the press).

[3] Ruffilli, D., *Boll. Lega Ital. Lotta Tumori*, **11**, 3 (1937).

A New Cardiac Glycoside?

Asclepias curassavica is very common in Queensland and parts of New South Wales and has often been suspected of poisoning stock. On testing, it was found that the liquid extract obtained by macerating 2 lb. of the plant in cold water killed a 600 lb. steer in fifteen minutes.

Investigation of the plant has shown that the toxic principle is a mixture of glycosides of the cardiac type. This mixture can be resolved into a chloroform-soluble group and a water-soluble group ; from the chloroform-soluble group a crystalline glycoside m.p. 130° C. has been obtained—this glycoside gives with concentrated sulphuric acid an orange colour changing to purple on contact with air and in the Kiliani test the acetic acid layer becomes green, a purple ring developing at the junction of the two layers on standing. The water-soluble group consists of an amorphous mixture which is hygroscopic and very soluble in water—this material gives a deep emerald green colour with concentrated sulphuric acid. Positive Legal and Baljet tests are obtained with the glycosides of both groups. The glycosides of both groups when tested in very small dose on frogs caused death in half an hour, the ventricles being arrested in systole—characteristic heart tracings were obtained. The action of the plant enzyme on the glycosides of the water-soluble group has also been investigated.

C. H. WILLIAMS.

Pharmacy Section,
Central Technical College,
Brisbane,
Qd., Australia.
June 3.

Allopolyploid Nature of the Wild Tetraploid Watercress

THE geographical distribution and behaviour of diploid, triploid and tetraploid watercress was described some years ago by one of us (I. M.[1]). The triploid was shown to be a hybrid between diploid and tetraploid, but the origin of the tetraploid was unknown. It was thought to be an autopolyploid partly on account of its close resemblance to the diploid and also because of the absence of an obvious alternative, Nasturtium being now generally regarded as a monotypic genus. The absence of multivalents from meiosis was thought to be due to the very small size of the chromosomes. That another interpretation must be put upon the facts regarding the tetraploid has now been shown by the following method.

In 1938 the original stocks used by Manton were communicated to Howard who treated young seedlings of the diploid with 0·5 per cent colchicine solution and thereby produced a genuine autotetraploid. It was at once apparent that this plant was not identical with the wild tetraploid. It showed all the features of darker colour, fleshier leaves and larger organs, characteristic of autopolyploids in general; but it did not show the slow growth, straggling habit and details of fruit shape that had been noted in the wild tetraploid. Moreover, its fertility was reduced and when crossed with the wild tetraploid the hybrid was highly sterile.

Investigation of meiosis by Manton has shown that whereas the wild tetraploid, as previously reported, forms 32 bivalents (the diploid forms 16), the real autopolyploid forms many quadrivalents, thus disproving the idea that their presence or absence has anything to do with chromosome size. The hybrid between wild tetraploid and the autotetraploid forms no quadrivalents but only trivalents, bivalents and a large number of univalents. The hybrid between wild tetraploid and diploid *Nasturtium officinale* (that is, the triploid previously described) forms, at least in the majority of pollen mother cells, 16 bivalents and 16 univalents. It is therefore clear that each gamete produced by the wild tetraploid contains 16 chromosomes (half its total complement) which are homologous with those of the diploid and artificial autotetraploid *N. officinale* and 16 other chromosomes which are non-homologous. The identity of the non-homologous chromosomes is not yet known, but it is expected that they will be found to belong to a species of the related genus Cardamine, particularly as the seeds in the wild tetraploid are uniseriate as found in Cardamine and not biseriate as found in diploid and artificial autotetraploid *Nasturtium officinale*.

In any event it is quite clear that 'wild tetraploid watercress' is not an auto- but an allo-polyploid, and in our opinion taxonomists would be well advised to treat it as a new species. It is hoped that a fuller account with illustrations will be published later.

H. W. Howard.

School of Agriculture,
Cambridge.

Irene Manton.

Botany Department,
University of Manchester.

---

[1] Manton, I., *Z. indukt. Abst.-u. Vererbgsl.*, 69, 132–57 (1935).

Shortage of Lavender Oil

In Nature of August 10, p. 193, in a note on "This Season's English Herbs", the statement is made—"a fair yield of English lavender oil may be expected for this season; more of the flowers will go to the still and less to Covent Garden in bunches for street vendors, and thus at least part of the shortage due to the lack of French oil will be made good".

When comparison is made between the acreage devoted to lavender cultivation in Great Britain with that devoted to a similar purpose in France, plus the acreage of the areas from which wild lavender is habitually collected for distillation—to say nothing of the acreage devoted to the cultivation of the hybrid lavandin—it is obvious that, quantitatively, increased distillation of English lavender will make good the deficit only to a very trifling extent. I believe that, normally, France distils about 150 times as much lavender oil as we do. Commercially, English lavender oil is also unable to make good the deficit because of the very high price it commands compared with the French oil.

Fortunately, in recent years lavender cultivation has been taken up in Kenya, and quite a good oil is produced at a price comparable with the French. Lavender oil is also distilled in Western Australia, and there is a *Lavandula Stoechas* oil of Portuguese origin available.

It seems certain, however, that the production of lavender water and other lavender-scented toilet requisites in Great Britain will tend to diminish and that prices will tend to rise. The sales tax will also tend to limit consumption. This is much to be regretted on grounds of public hygiene, since the antiseptic value of lavender oil, according to the well-known work of Cavel, is superior to that of phenol (carbolic acid).

H. S. Redgrove.

The Thatched Cottage,
Oxford Road,
Pangbourne, Berks.
August 17.

Formation of Protective Films

In Prof. N. F. Mott's interesting article in Nature for June 29, p. 996, he states that "in some metals, notably aluminium, oxidation stops altogether when the film has reached a thickness of the order of 10^{-6} cm., the protective films thus formed preventing further attack".

In measurements of the electrical resistance of such films[1] I obtained the following roughly comparative results:

Film resistance immediately after emery polishing under paraffin	1,651 ohms.
After 8 hr. exposure to moist air	2,501 ,,
Heating 8 hr. at 160° C. in air	4,511 ,,
Heating 65 hr. at 300° C. in air	8,381 ,,
Anodic oxidation film..	26,300 ,,

These increases in resistance would seem to indicate closer packing made possible by recrystallization, and to show that the final film thickness on aluminium is not greatly affected, even by long exposures at higher temperatures; this is in accordance with Prof. Mott's theory.

There is further the interesting suggestion that the oxide films of aluminium and zinc will dissolve metal. This is in contrast to a cuprous oxide film, and a means by which it can be distinguished from the amorphous metal which, according to Finch[2], will dissolve metal crystals, whereas the oxide will not.

L. H. Callendar.

30, Pine Road,
Didsbury,
Manchester.
August 9.

---

[1] *Proc. Roy. Soc.*, A, 115, 368 (1927).

[2] Nature, 137, 516 (1936).

RESEARCH ITEMS

Joking Relationships

THE custom whereby two people on meeting are required to joke, even to obscenity, with one another has been reported frequently from Africa, but is also well known as occurring among primitive peoples in other parts of the world. The general principles of this relationship have been examined by A. R. Radcliffe-Brown (*Africa*, **13**, 3; July 1940) who suggests that it must be taken in conjunction with the custom of avoidance. Frequently a man is on joking terms with his wife's brothers and sisters, but there may be partial or complete avoidance of his wife's parents. These relations then express states of social disjunction and conjunction set up by marriage. The basis of the distinction is the generation, and sometimes seniority within the younger generation. At the same time, while the preceding generation has to be treated with respect, very often the joking relation subsists between grandchildren and grandparents. It is to be noted too that the relation is found between nephew and mother's brother or other relatives, but the father's brothers are treated with respect. In addition to the tie of marriage affecting this relation, there is that of adoption and the alliance by exchange of goods or services which may also be connected with avoidance. An alliance by blood-brotherhood may be a joking relationship as among the Zande. The joking relationship in some ways is the exact opposite of a contractual relation. It must also be distinguished from the relations set up by common membership of a domestic group, a lineage or clan, each of which has to be defined in terms of a whole set of socially recognized rights and duties.

Gypsies of the Sárrét (Hungary)

IN an account by Istvan Nagy of Budapest (*J. Gypsy Lore Soc.*, Ser. 3, **19**, 3–4; 1940) of the gypsies of the Sárrét as they are to-day it is pointed out that the ubiquity of the gypsies in a village is no true index of their numbers. It is due to their volatile and active character in which they recall the activity and noisiness of the people of the south. Their life is entirely different from that of the peasant and causes mistrust, even though the peasant is extraordinarily tolerant. The house of the gypsy is wretched and small compared with that of the peasant. Mud-walled and clay-roofed, only in the newer dwellings are there even two rooms and roofs of reed or straw. The floor is of well-trodden earth, which is kept smooth and yellow with clay mixed with horse manure. The walls are whitewashed inside and plastered with chaffy mud outside. Heating is difficult if not impossible in winter, when the gypsies rarely leave the house but avoid intense cold by remaining indoors sheltering in their eiderdowns. When they gave up their nomadic life to settle in the villages, their traditional crafts disappeared largely owing to their lack of technical skill as compared with the trained smith or other worker. Now they engage in agriculture or horse trading. Their wealthiest men are horse traders, and to own a horse is matter for ostentation. Their standard of wealth is low, and they are improvident, squandering their earnings as soon as paid. Beside the horse they have no domestic animals. The favourite food is carrion-animals and poultry dead of disease, which they manage to obtain whatever the measures taken by the authorities to prevent them. In the matter of dress, their clothes bought secondhand and altered to suit their individual taste, are in this sense better in cut and original quality than those of the peasant. They are also brighter in hue. The women wear the most vivid reds and greens, and their hair is gay with ribbons and gaudy kerchiefs. In the hottest weather they wear three or four skirts.

Phenological Records in Great Britain

DESPITE the war-time difficulties of organized voluntary field work, both the Royal Meteorological Society and the British Empire Naturalists' Association are continuing to collect records of seasonal migration of birds, flowering of plants and similar events in Great Britain in the hope that the continuity of phenological work may not be broken. The British Empire Naturalists Association is summarizing the records sent in from its twenty-odd branches in a duplicated "Branch News", privately circulated. A new issue covering the first half of 1940 includes the rare marsh-sandpiper at Slough, Bucks., where a fairly constant watch also records such passage of birds as the wood-sandpiper, spotted redshank, Iceland gull, greenshank, whimbrel and sanderling. Bird migration began earlier than usual this spring, and there were many wild geese in the south of England. Unusual numbers of swifts were noted in Derbyshire, but fewer house-martins. In the south, the stag-beetles were very common, while the comma and white admiral butterflies have extended their range in the Sherborne district of Dorset. The Royal Meteorological Society has circulated to its numerous phenological observers a preliminary report on the 1939 field observations. With regard to hibernating brimstone butterflies, the date of emergence depends upon the accumulating warmth in their respective shelters, so that no general condition can be predicted; the males appear before the females as with most insects, but if the favourable weather conditions deteriorate they return to hibernation. The capricious appearance of these hibernated butterflies cannot form a reliable index to seasonal changes. A phenological organization is being set up in Canada, where the country has been divided into zones and selected species have been chosen for observation.

Note of the Anna Hummingbird

THE dive note of this American hummingbird, *Calypte anna*, is distinctive. It is produced by the male bird on the instant when it turns upwards after making a steep and rapid descent. The origin of this note has been argued about; but generally it is considered to be produced by flight or tail feathers. Thomas L. Rodgers has settled the point, as the 'drumming' of snipe was settled long ago, by simple experiments with various feathers (*Condor*, **42**, 86; 1940). Individual feathers and whole tails and wings were held in swift air currents, with the result that the only promising response came from the outer tail feathers, which are narrower than the rest, have a stronger vane and are curved outwards for half their length. These feathers attached to a slender strip of bamboo, when whipped through the air, produced a note almost identical with that of the bird. Immature males were found not to produce the note, and examination showed that the outer tail feathers in juvenile males were broader, especially towards the tip, and had a softer vane. They did not produce a note with the bamboo whip. The experiments might be repeated with the feathers, adult and juvenile, stuck into a cork whirled at the end of a string, the method which demonstrated the 'drumming' of snipe.

Feeding Habits of the Japanese Beetle

The Japanese beetle (*Popillia japonica*) was first found in the United States in 1916 at Riverton, N.J. It has, in the meantime, spread into six States, and by 1938 the areas continuously infested by this insect covered 15,100 square miles. Circular No. 547 of the U.S. Department of Agriculture (May 1940) by I. M. Hawley and F. W. Metzger enumerates 275 species of plants known to be fed upon to a greater or lesser degree by the adult beetle. In feeding, it normally eats out small portions of the leaf surfaces, leaving the veins untouched. The leaves thus skeletonized turn brown and usually fall from the plants. The beetle is gregarious and often collects in masses or 'balls' and feeds extensively on such preferred fruits as apples and peaches until only the core or stone remains. The feeding behaviour varies with atmospheric humidity and temperature. When the latter is below 70° F., feeding is light: it is heaviest between 85° F. and 95° F., but above 95° F. it is light. When relative humidity is below 50–60 per cent, the beetles fly actively but feed relatively little. Above 60 per cent humidity feeding is vigorous. The one known factor that makes many plants attractive to *Popillia* is the high content of reducing sugar in the part of the plant usually fed upon. Of the many plants liable to attack, severe injury results to many kinds of fruit trees, also certain Malvaceæ, soybean, elm, poplars and some kind of grape, etc. To many other plants injury is moderate or slight. Some plants such as geranium, castor-beans and bottle-brush buckeye are reported to kill the beetles after feeding on them.

Parasites of Chafer Larvæ in Africa and France

L. Andre Moutia, assistant entomologist, department of Agriculture, Mauritius, has recently discussed the above subject (*Bull. Entomol. Res.*, June 1940). He describes an extensive survey, lasting eighteen months, that was carried out in Zanzibar, Algeria, Morocco and parts of France. The object of the survey was to obtain a supply of parasites of Melolonthid larvæ or 'white grubs'—for furthering the control of these latter creatures in Mauritius where the species *Phytalus smithi* has been a long-standing pest of sugar-cane. In Zanzibar it was disclosed that white grubs are of no special economic importance and also their rate of infestation by parasites is very low. In Algeria no effective means of control of this pest was obtained, and in France control is mostly done by flooding. In Morocco, parasitism by a Tachinid fly *Dexiomorpha picta* Meig., averaged 1·5 per cent but ranged up to as much as 16 per cent locally. The bionomics of this parasite is fully discussed and the morphology of the various stages in the life-cycle are described and figured. Larvæ were transmitted to Mauritius and kept in cold storage at 4–6 C. and the survival rate was 49–80 per cent. The percentage of flies emerging from the parasitized white grubs ranged from 10 to 26·9. It appears that the Dexiomorpha is the only Tachinid worthy of further attention, and it is very desirable that importation of it in large numbers should go on so as to render available sufficient quantity for release in Mauritius. The species in question is stated to be the most promising parasite yet discovered.

Red Core Root Disease of Strawberry

In recent years strawberry crops in Scotland have been seriously reduced by 'Lanarkshire disease', characterized by withered leaves, decayed roots, and a red colour in the central cylinder of the roots. A similar disease has been reported from the United States. Outbreaks of the disease have now been reported in various places in England, and the fungus responsible has been isolated in pure culture by C. J. Hickman (*J. Pom. & Hort. Sci.*, 18, 89; 1940). The morphological and physiological characters of the organism have been described and its pathogenicity proved experimentally. The name *Phytophthora Fragariæ* has been assigned to it; it differs from all previously described species of Phytophthora. The severity of the disease is closely related to soil moisture conditions, being worst where water content is high on account of impeded drainage. The strawberry roots become invaded at their tips, and the fungus passes backward through the central cylinder, which becomes reddened. This has given rise to the name 'red core disease'. The plant remains small during late spring and early summer, and the foliage wilts and finally dies. None of the common varieties grown in Great Britain is immune, though Pillnitz, Early Cambridge, and Oberschlesien are fairly resistant. Four new seedling varieties bred in Scotland have been found to be immune. The breeding of immune varieties promises to be the only reliable means of control, though there is some indication that the disease may be inhibited by soil alkalinity.

Evolutionary Chromosome Change in Sciara

C. W. Metz, of the Department of Embryology, Carnegie Institution of Washington, read a paper on this subject at the Eighth American Scientific Congress. On the assumption that evolutionary changes are initiated in the chromosomes, an attempt is being made to throw light on such changes by a study of both spontaneous and induced chromosome alterations in fungus flies of the genus Sciara. A comparison of the phenomena observed in Sciara with those found in Drosophila has revealed striking differences which may have evolutionary significance. As shown by the work of Dobzhansky, Sturtevant, Bridges and others, spontaneous chromosome changes in Drosophila, as detected both in wild strains and in species hybrids, consist mainly of gross chromosome rearrangements such as inversions and translocations of chromosome segments. Minute modifications are relatively rare. In Sciara, on the other hand, the situation seems to be just the reverse. Minute modifications, which appear to represent small deficiencies and duplications of the chromatic disks, are detected frequently in wild strains and in species hybrids, whereas gross rearrangements appear to be almost entirely lacking in the material studied (of four species and one species hybrid). These results suggest that there is a difference in the underlying chromosome mechanism in the two genera and that evolution may possibly be following different trends in the two. Experimental studies on the nature of changes induced by irradiation are being used to throw further light on the problem. The latter, carried out in co-operation with R. D. Boche and Martha Lee Bozeman, have shown that in Sciara gross chromosome rearrangements are readily secured by irradiating sperms, but that few if any modifications are induced by irradiating eggs (at least in their later stages). In these eggs the chromosomes are in an apparently typical prophase condition, consisting of long threads (tetrads) which, from analogy with other organisms, should be sensitive to irradiation. A special effort is being made to ascertain what physical conditions in the nucleus are responsible for the resistance in the present case, in the hope that this may throw light on the mechanism underlying rearrangement or other modification of chromosome materials.

Genetical Studies on the Lady-Bird

Y. Hoshino (*J. Genet.*, 40, 215–228 ; 1940) shows that the spots and colour of the elytra of ladybird beetles are inherited as an autosomal multiple allelomorphic series. The varieties in this series are *succinia*, *axyridis*, *spectabilis*, *conspicua*, *forficula*, *transversifascia* and *aulica*. Heterozygotes involving *succinia* or *axyridis* can usually be distinguished from the corresponding homozygotes.

Plasticity Conditions for the Formation of Faults

This subject is considered further in a second paper by K. Sezawa and K. Kanai (*Bull. Earthquake Res. Inst.*, Tokyo Imperial University, 18, Part 1 ; March 1940). They investigate mathematically the stress and strain distributions in a surface crustal block bounded by one original fault, the plastic condition being taken only in the sense of maximum shear stress. The idealized problem is, however, chosen only as a working hypothesis, and the treatment of a block bounded by many original faults may be a more general one ; also a somewhat similar result may be possible with a folded crust. As a result of this and the preceding investigation (Nature, July 27, p. 136) it appears that, although a normal fault is formed in a crustal block bounded by original faults, the origin of the reverse fault is not restricted to local conditions but is related to the deformation of the entire earth, particularly in its early historical stage. The authors conclude that whereas the faults found in the Japanese Islands would be of reverse or normal type, those that neighbour the Japan Trench, or large faults in the continent of Asia, would probably be of reverse type.

Japanese Earthquakes, January–June 1939

During the first half of 1939 there were no violent earthquakes felt in Tokyo and none which the Japanese call strong. (Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University, 1939, Part 1–2 ; January 1–June 30, 1939). Altogether there were 26 earthquakes felt in Tokyo during this period of which 23 were classed as slight, 2 as rather weak and one, on the tenth of March, as weak. This latter had an amplitude of 262 μ in Tokyo with a maximum acceleration of 0·19s. Its epicentre was 36·15° N., 137·91° E., to the west-north-west of Okiziku and north-north-west of Tokyo. With only three exceptions, the epicentres of the 26 shocks lie roughly in the shape of a letter L with the angle near the epicentre just mentioned, and the upright branch running roughly north-east. Both branches extend into the sea bed.

Earthquakes of the U.S. Atlantic Coastal Plain

This subject is discussed by N. H. Heck (*Bull. Seis. Soc. Amer.*, 30, No. 2, April 1940), who states that the seismicity is definitely related to the geological structure of the region between the fall line and the coast. In this region earthquakes of Rossi - Forel scale intensity 5 or over are rare except near Charleston. Forty-five epicentres with repetitions and about 90 distinct earth shocks have been distinguished outside the Charleston-Summerville area though undoubtedly some have escaped notice in the past. The double epicentre Charleston S.C. earthquake of 1886 was one of the greatest which have occurred in the world. Since this great earthquake, shocks from the same epicentres have persisted to the present time with only 8 years when no shocks were recorded, though the numbers per annum of these have considerably fallen off since 1893. The author suggests that there should be an active seismological station set up in Virginia and at least one other farther south to assist in the location of the considerable amount of earthquake activity in the Appalachian region. In the absence of such stations, an appeal is made to geologists in the districts where earthquakes occur to send immediate information to the U.S. Coast and Geodetic Survey at Washington, D.C.

Photographic Proper Motions in the Præsepe Cluster

P. C. Chaudhuri has investigated the proper motion of the members of the Præsepe Cluster (N.G.C. 2632) (*Mon. Not. Roy. Astro. Soc.*, 100, 5 ; March 1940). Van Rhijn and Wassink have already discussed the proper motions of the members of the cluster, and the latter found that the centennial proper motion was 3·7″ in position angle 249°. Accurate proper-motion data have been obtained by the Radcliffe plates, which have the great advantage of a long-time interval of 30·1 years between the early and the new plates. The measuring machine is of the Repsold type and furnishes measurements in one direction only. The scale of the micrometer is such that one unit is equal to 0·00025 mm., that of the Radcliffe telescope being given as 1 mm. = 30″ ; hence the scale adopted in the present paper is one unit equal to 0·0075″ in 30·1 years. It was a simple matter to separate the cluster from the non-cluster stars. When the equatorial components of proper motion are plotted, the cluster stars show a marked concentration around a certain point while the non-cluster stars exhibit a scattered distribution. It was found that there were a hundred cluster stars in the region covered by the plates. Of stars brighter than magnitude 9 there was only one classified as non-cluster, and between magnitudes 9 and 11 there were 39 members and 13 non-members. There is a decided preponderance of brighter stars as members of the cluster. The proper motion components of the hundred cluster stars are shown in Table ii, arranged in eight groups according to magnitudes, and there is practically no magnitude error in the components. The centennial group-motion is 3·9″ in position angle 242·9°.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN AUSTRALIA

THE thirteenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ending June 1939 (Canberra: Commonwealth Gov. Printer, 4*s*. 6*d*.). The Council was established in 1926 by the reorganization of the existing Institute of Science and Industry, and the powers and functions of the Council are defined by the Science and Industry Research Act, 1920–39. They include the initiation and carrying out of research in connexion with, or for the promotion of, primary and secondary industries, the training of research workers, the making of grants-in-aid of pure research, the testing and standardization of scientific apparatus and instruments, the carrying out of scientific investigations connected with standardization and the establishment of a Bureau of Information relating to scientific and technical matters. The report refers to progress in the erection of the National Standards Laboratory and the Aeronautical Research Laboratory. The erection and equipment of a laboratory for the Fisheries Section was completed during the year at Port Hacking, south of Sydney. Reference is made in some detail to investigations on plant introduction, pasture plant breeding and investigations on pastures. Other investigations of the Division of Plant Industry cover experiments planned for a period of five years on the root rot of wheat, as well as seed-bed experiments on the control of downy mildew of tobacco which refer to the successful results obtained with benzene vapour and also with Shirlan compounds and alum-lead acetate as cover dressings. Studies on the nature of the virus diseases of Australian potatoes have also been continued by the Division.

The Division of Economic Entomology records the successful introduction and establishment of some parasites of insect pests and of one insect introduced to control the weed lantana. Improved methods of controlling the common household pests, silver fish, meat ants and small black ants have been developed during recent years. During the year, sheep blowfly investigations have concentrated attention on the study of attractants and repellants, the investigation of poisons and examination of dressings. Investigations on orchard and fruit pests included a study of the oriental peach moth and work on phenothiazine and its derivatives to control the codling moth. Special attention has been given to the problem of the direct control of termites, and laboratory and field experiments have indicated some of the reasons, apart from their higher toxicity, for the superiority of arsenicals over silicofluorides. Investigations on weeds have included a study of the relation between certain physical properties of translocated sprays and their rate of penetration into leaves, involving a study of the wetting ability of a spray.

The Animal Health Research Laboratory at Belmont has continued its investigations on pleuropneumonia in cattle as well as on mastitis in dairy cattle, while the work of the McMaster Animal Health Laboratory has included investigations on the effect of nicotine sulphate on *Hæmonchus contortus*, as well as on the efficiency of anthelmintics, including phenothiazine. Other work has been concerned with studies on fleece chemistry including the wool fibre, the properties of wool wax, the suint and the dirt, as well as on the physical characteristics of wool, on the ecto-parasites of sheep, and sheep dipping and investigations on foot rot, coast disease of sheep, and cobalt- and copper-deficiency in ruminants. The work of the Division of Soils has included an investigation of the fertilizers used in Australia as well as studies in soil microbiology.

The Commonwealth Research Station at Merbein, Victoria, has continued its studies of soil preservation and reclamation; the work has included the preservation of soil fertility, studies in viticulture and fruit processing and examination of new fumigants. At the Irrigation Research Station, Griffiths, in New South Wales, studies on plant nutrition and also on the root system of plants with special reference to citrus fruits have been undertaken. Marked developments have also taken place in the work of the Division of Forest Products; a new Section for Veneers and Plywood and the completion and equipment of a laboratory for experimental pulp and paper studies are announced. A timber handbook has been prepared for publication to provide engineers and architects with tabulated data on the strength properties of Australian timbers in a form suited for the designer. Service tests have been continued on a large number of wood preservatives, and laboratory investigations have indicated that low concentrations of boric acid render susceptible sap wood immune to Lyctus attack, the lethal concentration being about 0·12 per cent. Details for commercial treatment have been developed and successful results obtained on commercial plants erected in Queensland. Other investigations have covered the glueing characteristics of Australian timbers and the testing of glues.

Investigations on food preservation have covered a wide range, from chilled beef and the use of ozone as a preservative in the ripening or conditioning of beef cuts to the completion of a survey of wastage of oranges in Australia and mandarins in New Zealand. The effects of maturity at picking time, district, application of boron to the tree and to the soil, delayed storage and temperature storage are being studied with Jonathan, Delicious, Democrat and Granny Smith apples, and factors associated with wastage in many varieties of pears in New South Wales are being investigated. The conclusion that gas storage can increase the storage life of less mature fruit, but may have a reverse effect on more mature fruit, has been drawn from experiments with pears as well as from experiments with peaches and plums. Other investigations of the Division have been concerned with the preparation and preservation of fruit juices and with can lacquers, and to discover corrosion-resisting, non-tainting lacquers suitable for internal application to tin-plate containers. The smoking of fish, the export and storage of eggs and the permeability to water of wrapping materials have all been handled by the Division.

Fisheries investigations have continued on tuna, as well as on pilchards, etc., and the determination of the sources and degrees of fish spoilage.

The report also refers to the work of the Radio Research Board, of the Commonwealth Prickly Pear Board, to ore-dressing investigations and to the work of the Information Section.

ECOLOGICAL BASIS OF LAND USE AND MANAGEMENT*

By Paul B. Sears,
Oberlin College, Ohio

LAND use and management involve a wide range of human adjustments to environment. This range extends from purely physical problems on into those of social relationship. The only scientific rubric embracing such a wide field is that of ecology. This is not to assume for ecology any greater authority than other sciences possess, but merely the right to try to develop a symbolism and method suitable to its approach.

The ecologist conceives of the living community as a highly integrated expression of solar energy. The measure of ecological or biological potential is in the degree to which such energy is stored and utilized before its final loss through entropic change. The degree of organization of the soil is a concomitant aspect of biological potential. Efficient natural communities and mature soil, therefore, afford norms for judging human culture patterns as they affect the landscape.

Modern science has been applied chiefly to elaboration of finished goods from raw materials. It needs also to be applied to the conservation of energy and materials, and to distribution. No sound programme of land use and management is possible except on this basis. For reasons other than abstract political theory, I believe that such adjustments can best be made within flexible regional communities, with considerable local initiative. The emphasis in such communities must inevitably be less on profit and more on design.

The basis of adjustment lies in ecological diagnosis. Through a study of physiographic processes, climatic pattern, soil development, biological stabilization, and the water cycle it can readily be determined whether the biological potential of a given landscape is being lost or maintained under the impact of a particular human culture form. Technical remedial measures are frequently obvious; the necessary social changes more obscure and difficult.

The present trend of land use must be reversed to give a maximum of natural communities and a minimum of ploughland, the latter more carefully chosen and handled than at present. Intermediate areas, such as pasture, must be adjusted to actual need. Such a programme will eventually increase real wealth and the population capacity of the land. An important and immediate need is to lessen the pressure for cash income from land.

Studies are needed of mixed cropping plans which will simulate natural communities, and of methods of tillage and humus return which are less violent than those now in use and which more closely simulate Nature. A much wider strategic and incidental use of permanent vegetative cover in drainage ways, fence-rows, etc., is already discernible, and is justified ecologically. In the cultural realm much may be learned from the occasional human communities which have developed and maintained a sound working relationship with the landscape.

---

* Substance of a paper read at the Eighth American Scientific Congress.

CHANGES IN THE BRITISH PHARMACOPŒIA

THE first of the war-time emergency supplements to the British Pharmacopœia, which was outlined in NATURE of June 8 (p. 889), became official on June 15. It is not improbable that a second addendum will be published later containing monographs on certain synthetic drugs of the type known as new remedies, for the supply of which Great Britain has hitherto depended upon foreign sources which are not now available. There is also a need for a third addendum to supply formulæ for sweetening preparations for use in place of sugar compounds; indeed, it seems desirable that standards should be laid down for such preparations as soon as it is convenient to do so, in view of the announcement by the Ministry of Food that no new permits to manufacturers to obtain sugar supplies can now be considered.

The addendum dealing with synthetic drugs would rechristen the products selected for inclusion; pharmacopœial names will take the place of the original proprietary names; thus "Doryl" will become "Carbachol"; "Fouadin" will be renamed "Stibophen" and "Coramine" will be officially called "Nikethamide". The selection for inclusion in the addendum will be made only from such drugs as are now being produced, or will shortly be produced, by British manufacturers.

The problem of substitutes for sugar compounds is less easy than would appear at first sight; it is not merely a question of sweetness; it is also desirable that so far as is feasible the substitute should be of the same density as the sugar preparation and should possess, in certain cases, preservative properties. In many instances no doubt saccharin or glycerin would serve the desired purpose so far as the sweetening factor is concerned, and it is interesting to note that saccharin is now manufactured on a large commercial scale in Great Britain and that up to the present medicinal glycerin has been obtainable at the same prices as were quoted before the War began; the by-product of the soap industry has been ousted from the prominent position it formerly held in respect to the manufacture of high explosives. What appears to be a valuable suggestion was made recently by a member of the Council of the Pharmaceutical Society, Mr. J. C. Young, who, in an address on the subject to a branch meeting of the Society, suggested that manufacturers who introduced new compounds should not use sugar but some alternative for it. By this means there would be an avoidance of change of appearance and taste of the compound in the event of it becoming necessary to forgo the use of sugar.

ORIGIN OF THE SOLAR SYSTEM

R. A. LYTTLETON has now prepared a detailed defence of his theory of the origin of the solar system against various criticisms urged at different times (*Mon. Not. Roy. Astro. Soc.*, **100**, 7 ; May 1940). In the short compass of the present note it is impossible to consider in detail the contents of the paper, which should be read by all interested in problems of cosmogony. A few outstanding points are worthy of special attention.

It will be recalled that the theory was first put forward in 1936 (*Mon. Not. Roy. Astro. Soc.*, **96**, 559 ; 1936). Luyten criticized various features of the theory, and, *inter alia,* pointed out that hydrogen would readily escape at high temperature from the filament from which the planets were evolved. Lyttleton shows that, while the lightest elements would escape from the filament or primitive planet, such gases would not necessarily escape from the sun. They would form a tenuous medium, possessed with angular momentum, through which the planets would move. As the planets would pick up lighter gases after their initial formation from the heavier elements, the presence of hydrogen on the major planets is no objection, as Luyten believed, to Lyttleton's theory.

Another important matter is the amount of energy required to remove the planetary material. Luyten and Hill pointed out that the energy necessary to generate the planets from the companion to the sun must have been so large that the visiting star would have required a velocity of the order of 100 km. a second. In these circumstances the centre of the ribbon from which the planets were formed would have possessed a velocity far beyond the escape velocity relative to the sun. In the present paper, Lyttleton deals with some simple quantitative results and shows that in his reply in an earlier paper it was unnecessary to postulate so large a relative mass for the intruding star. In fact, there is no justification for assuming that the energy could be supplied only by a star of exceptionally high mass.

Other points are dealt with, such as the objection to the complexity of the theory, which, Lyttleton shows, is not a valid objection. Nor can the difficulties regarding the filament be urged as serious when it is remembered that the generally accepted views concerning the development of the filament were current before he propounded his theory, and hence he is not responsible for them. He admits at the end of the paper that, while his own theory is not really open to any objection, this does not preclude the possibility that other explanations of the origin of the solar system may be devised.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Part-time Teachers of Engineering Drawing (S.1), Electro-Technology (D.C.) (S.3), Theory of Machines (A.1), Engineering Drawing and Design (A.2), Electrical Engineering—Measurements (A.2), and Electrical Engineering—Distribution and Utilization (A.2)—The Principal, Twickenham Technical College, Egerton Road, Twickenham (September 4).

Assistant Secretary for Higher Education—The Secretary for Education, County Offices, Aylesbury, Bucks (September 7).

Deputy Director of Education—The Director of Education, Education Offices, Union Street West, Oldham (September 7).

Engineer to the Middle Level Commissioners—The Clerk to the Commissioners, Middle Level Offices, March, Cambs. (September 10).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 2, No. 17 : The Energy Levels of a Rotating Vibrator. By Dr. Ian Sandeman. Pp. 210–223. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) 1*s.* 3*d.* [128

Other Countries

Journal of the Federated Malay States Museums. Vol. 18, Part 4 : New Genera and Species of Malaysian Reduviidae (Part 1). By N. C. E. Miller. Pp. 415–600. (Kuala Lumpur: F.M.S. Museum.) [98

Proceedings of the United States National Museum. Vol. 88, No. 3082 : Revision of the Chalcid-Flies of the Tribe Chalcidini in America North of Mexico. By B. D. Burks. Pp. 237–354. Vol. 88, No. 3084 : The Scolytid Beetles of the Genus *Renocis* Casey, with Descriptions of Nine New Species. By M. W. Blackman. Pp. 373–402. Vol. 88, No. 3087 : A Review of the Parasitic Crustacea of the Genus *Argulus* in the Collections of the United States National Museum. By O. Lloyd Meehean. Pp. 459–522. (Washington, D.C. : Government Printing Office.) [98

Memoirs of the Geological Survey of India. Vol. 70, Part 2, No. 2 : An Attempt at the Correlation of the Ancient Schistose Formations of Peninsular India. By Sir Lewis Leigh Fermor. Pp. iv+219–324+plates 2–4. (Calcutta : Geological Survey of India.) 1.12 rupees ; 2*s.* 6*d.* [98

Memoirs of the Geological Survey of India. Palaeontologia Indica, Series 9, Vol. 3, Part 3 : The Jurassic Lamellibranch Fauna of Kuchh (Cutch). By Dr. L. R. Cox. Pp. vi+158+10 plates. (Calcutta : Geological Survey of India.) 9.10 rupees ; 15*s.* [98

Proceedings of the Second Session of the Indian Statistical Conference held in Lahore, January 1939. Edited by P. C. Mahalanobis. Pp. ii+168. (Calcutta : Statistical Publishing Society.) [98

Department of Public Instruction, Technical Education Branch, New South Wales. Technological Museum : Curator's Annual Report for Year ended 31st December 1939. Pp. 4. (Sydney : Government Printer.) [128

Annual Review of Biochemical and Applied Research in India. Vol. 10, 1939. Pp. iii+168. (Bangalore : Society of Biological Chemists.) 3 rupees ; 6*s.* [128

U.S. Department of the Interior : Geological Survey. Bulletin 912 : Spirit Leveling in Utah, 1897–1938. Pp. iii+222+2 plates. 30 cents. Bulletin 916–C : Transit Traverse in Missouri. Part 3 : East-Central Missouri, 1903–37. Pp. x+297–460+xi–xiv+1 plate. 20 cents. (Washington, D.C. : Government Printing Office.) [128

U.S. Department of the Interior : Geological Survey. Water-Supply Paper 841 : Geology and Ground-Water Resources of the Harney Basin, Oregon. By A. M. Piper, T. W. Robinson and C. F. Park, Jr. ; with a statement on Precipitation and Tree Growth, by L. T. Jessup. Pp. vi+190+20 plates. 1 dollar. Water-Supply Paper 843 : Floods of December 1937 in Northern California. By H. D. McGlashan and R. C. Briggs. Pp. viii+498+18 plates. 60 cents. (Washington, D.C. : Government Printing Office.) [128

Western Australia : Geological Survey. Bulletin No. 97 : The Geology of the Yilgarn Goldfield, South of the Great Eastern Railway. By H. A. Ellis ; with an Appendix by Dr. Dorothy Carroll on "Sand-Plain Soils from the Yilgarn Goldfield". Pp. 192+7 plates. (Perth : Government Printer.) [128

Western Australia. Annual Progress Report of the Geological Survey for the Year 1938. Pp. 34+8 plates. (Perth : Government Printer.) [128

American Philosophical Society held at Philadelphia for promoting Useful Knowledge. Year Book 1939, January 1, 1939–December 31, 1939. Pp. 494. (Philadelphia : American Philosophical Society.) [128

Field Museum of Natural History. Geological Series, Vol. 8, No. 1 A New Turtle of the Genus *Podocnemis* from the Cretaceous of Arkansas. By Karl P. Schmidt. Pp. 12. 15 cents. Zoological Series, Vol. 24, No. 14 : A New Venezuelan Honey Creeper. By Emmet R. Blake. Pp. 155–158. 10 cents. Zoological Series, Vol. 24, No. 15 : A New Savannah Sparrow from Mexico. By Sidney Camras. Pp. 159–160. 10 cents. (Chicago : Field Museum of Natural History.) [138

Industrial Research Bureau. Bulletins of Indian Industrial Research, No. 16 : The Manufacture and Application of Liquid Gold. By Dr. Atma Ram, Dr. Karimullah and Dr. Lal C. Verman. Pp. 20. (Delhi : Manager of Publications.) 6 annas ; 7*d.* [138

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, SEPT. 7, 1940 No. 3697

LEADERSHIP IN RECONSTRUCTION

ONE of the most encouraging features of Prof. K. Mannheim's admirable study "Man and Society in an Age of Reconstruction" is the vista he opens out before us of the possibilities in the use of the study of society along scientific lines in the actual task of reconstruction. With a right conception of planning and the wise use of the appropriate technique, it should be possible to plan and to build a social order in which are preserved the freedom essential for creative work and moral and intellectual development and the harmony essential if men are to live together in an ordered society.

Prof. Mannheim's conception of planning, as of freedom, is dynamic. Man's needs change no less than the form in which those needs are expressed or served. Our task in this time of crisis and change is the dynamic one of bringing creative thought and constructive effort to bear, so that the organization of society is not left to chance or irrational forces but guided with the inspiration which comes from bringing all our available scientific energy and insight to bear on the understanding of the situation and the control of the determining factors.

The records of the War of 1914–18 show that we were able to look forward, even amid the preoccupations of some of its darkest years, and to plan and build for the future with such measures as the Education Act, the Representation of the People Act, the Sex Disqualification (Removal) Act and others of a like type, to which an admirable broadsheet of PEP (Political and Economic Planning) has directed attention. To-day the disturbance to the social and economic life of the country is even more profound. At the same time, the opportunities of reconstruction are opening up before us still more freely and widely. Democracy has a greater chance than ever of demonstrating its enduring value, its link with the imperishable elements in our moral heritage, by taking the expedients temporarily forced upon us by war, and with the necessary adjustments building them into the permanent structure of our mode of life. In the same way, advantage can be taken of the opportunity afforded by the crumbling of prejudice or privilege under the demands of war economy to make advances which in peace-time have long been delayed by vested interests. In the working out of new and dynamic conceptions of freedom and discipline, a final reply can be given to the totalitarian taunt of effete or decaying democracy.

The elaboration of a complete programme at the present time is both premature and undesirable. To arouse a general awareness of the opportunities, to stimulate a creative and adventurous outlook, so that in our thinking about immediate problems there is awareness and subconscious, if not deliberate, thought about the way in which they can be linked up with the post-war problems, is sufficient. If only this be done, a vital part of the preparation for further advance will have been carried out, the lack of which was a main hindrance after 1918. Without the adequate preparation of public opinion, the creation of a Ministry of Reconstruction by itself could achieve little. New forms of freedom will always be rejected until, as Mannheim points out, men have been prepared spiritually for them and ceased to think in terms of an earlier phase of social existence.

Reference has been made from time to time in these columns to some of the possibilities in regard to nutrition and health and the standard of living which might flow from a far-sighted food policy, embracing production, distribution and storage, agriculture and horticulture, initiated primarily to meet our war-time requirements. Another complex problem which should not be approached from the point of view of war effort alone is the most effective utilization of man-power in production and in the armed forces. The immense powers of the Minister of Labour and the Minister of Supply in regard to the control and dilution of labour, the utilization of skilled or professional labour of all kinds, the introduction of women and of part-time labour, the deflection of production and labour from non-essential industries, if wisely exercised in connexion with adequate short-term and long-term training policies, should make an important contribution to the solution of the unemployment problem.

This point is the central theme of a recent pamphlet "Post-War Poverty and Unemployment can be Prevented" by T. W. Wyatt and D. Caradog Jones (J. Woolman and Sons, Dacre Street, Birkenhead. 6*d*.). If economic depression and unemployment, can be temporarily cured by war, a better and more radical cure must be possible under conditions of peace. Pointing out that to all intents and purposes the War is being paid for as it is waged, that under war conditions money is not the essential consideration, and that the great mass of production and service utilized for war purposes is supplied in Great Britain, the authors argue that if the situation is properly handled by the Government, a repetition of the economic depression and serious unemployment which followed the War of 1914–18 is not inevitable. It should be possible, when peace comes, to change over from war production to peace production, and so make use of our vastly increased capacity for creating new wealth.

To utilize effectively the immense potential power of production, a carefully thought-out plan is essential, co-ordinating all forms of industrial activity. Messrs. Wyatt and Caradog Jones consider that their aims can be achieved under the present economic system, where private enterprise has free play, subject only to the appropriate Government control. Demobilization, for example, should be carried out gradually and systematically, and all who have given their service to the country should continue to receive full pay until they are absorbed again into industry. The aim of those directing affairs should be so to adjust spending, whether by taxation or rationing, that supply keeps step as nearly as possible with demand. If private enterprise proves insufficient within a reasonable time to absorb all demobilized men and women and to maintain consumption, public works should be instituted. There is no limit to work of this kind that might be done. Roads and transport, forestry, town- and country-planning, water supply, and electric power distribution provide innumerable opportunities, and no consideration of cost should interfere with the Government programme, provided only that the work undertaken is thoroughly and efficiently executed.

Discussing the possibility of inflation, Messrs. Wyatt and Jones believe that an expansion of currency for such purposes is safe until our resources of man-power and machinery are fully and adequately employed. They make the further point that in this new order we must school ourselves to a greater willingness to contribute gladly from our surplus income for social purposes. A planned economy is also essential because in due time it will be necessary to regulate the speed of production. The primary aim of the Government should be to adjust its financial policy so that an expanding market is always available for the goods produced. They further consider that by a systematic and continuous increase in production we can raise the standard of living all round.

To meet the new situation intelligent organization and administrative ability are the gifts which will be most in demand. Skilled workers will also be required for key positions; they may not be immediately available in sufficient numbers, and some may have to be trained. If, however, the problem is attacked on scientific lines and an honest attempt made to utilize fully the available resources, these needs can be met.

A constructive postscript to the pamphlet by J. R. Bellerby suggests that the post-War period will be marked by five fairly distinct phases. An initial phase of momentary depression is likely to be followed rapidly by one in which labour is fully employed in capital reconstruction, and Government action in this phase is of the utmost importance. The transformation of the Ministry of Supply into a Ministry of Reconstruction with specific powers to guarantee priority in the requisition of raw materials, machinery and services for the most vital consumptive goods, to control demobilization, adjust the flow of gratuity payments to the Forces, and postpone public or semi-public works, would be vital contributions. This phase would, if managed well, merge into a third phase in which there would be no serious shortage of essential consumable goods. In this stage an additional amount of deferred pay and gratuities to the Forces could be released. These three phases, throughout which the national budget is likely to remain unbalanced, would be followed by a fourth phase, characterized by a lack of consuming power, and at this stage the Government would have in reserve all the public and semi-public works it had been able to postpone. The real post-War test, however, would come at the fifth stage, when these schemes had been exhausted and the true remedy must lie in the unconventional and the costly. We have to learn the methods by which a controlled economy can be worked, and create a race of men and women as competent to administer British industry in the general interest as their grandfathers were to administer the other functions of the State.

We must, it is true, temper this note of optimism and hopeful view by the realization that there are still backward and recalcitrant elements in our midst. Even in regard to food, it is a damning indictment of the management of hospitals and other institutions, calling for immediate and drastic action, that the Ministry of Food should need even to issue a suggestion that the present abundant supplies of fresh fruit and vegetables should be used in place of drawing on reserves of canned supplies. Widespread uneasiness has also been caused by Mr. Bevin's recent disclosure in the House of Commons that some employers have failed to respond to his appeal regarding training of men at the higher and lower levels of skill. The reluctance of the Government to use its powers of compulsion has been the subject of as much criticism as its apparent absence of any clear policy in regard to the introduction and training of women, the industries or sources from which they are to be drawn and the equally important problem of utilizing on war work the labour compulsorily evacuated or transferred from defence areas.

These disturbing signs are evidence that one of our greatest tasks to-day is that of finding leadership of the requisite competence and integrity in politics, in industry, in finance, in art, in journalism, in the Civil Service. The raw material of leadership is as abundant as ever, but we can no longer claim that our social system is selecting and throwing up ability with the same outstanding efficiency and success as in the past. For this reason alone a thorough overhaul of our educational system is a vital necessity.

A prominent feature of the present situation is indeed that in general outlook the community is often far ahead of its leaders. In one field after another, in finance, in criticism of the budget or of labour, in the utilization of part-time services, alike for munitions production or in civil defence, the cry is that enough is not being demanded of us, insufficient guidance is being given, and inefficient use made of willing service. This feature has implications the importance of which can scarcely be overstressed.

In the planning to which we have referred we are in essence outlining a Bill of Human Rights embodying the minimum requirements for decent living, including the basic guarantees of the individual, such as freedom of speech, writing and religion, the right to a fair trial, the subordination of all government to the rule of law, the establishment of minimum standards of housing, food, education and medical care; and the provision of security against unemployment, accident, widowhood and old age. The presence of this widespread spirit of service in the community is one of the strongest safeguards against any undermining of the sense of individual social responsibility in the process, which Prof. Mannheim remarks must be carried out before planning can work smoothly, of abolishing the more blatant differences in wealth and opportunity.

It is of vital importance that this spirit of service should be canalized into some more permanent form. The counterpart to a Bill of Human Rights should be, as a recent leading article in *The Economist* has suggested, a Bill of the Duties which the citizen owes to the community of which he is a member. The minimum of rights will be the more cherished if it is paid for by a minimum of duties. Out of the fabric of relations involved in civil defence and the like, we may well evolve a new conception of the 'good neighbour'. We must now think of the community, the commonwealth, to which we give, from which we receive, of which we are all members, rather than of the State as an impersonal dispenser of free doles, or hard levier of taxes.

Here indeed is an ideal which should receive whole-hearted support. We are beginning to realize that we must plan the whole of our society and not merely parts of it, and that in planning parts we must have regard to the fate of the whole. We are learning individually to take a progressively longer view, and in the process the faculty of considered judgment is inculcated. Widespread evidence to-day shows that more and more men and women are becoming fit to share the responsibility for planning the whole course of events in the society in which they move.

MEDICAL SERVICE IN WAR

Organization, Strategy and Tactics of the Army Medical Services in War
By Lt.-Col. T. B. Nicholls. With Chapters by Air-Commodore A. S. Glynn, Col. A. R. Laurie and Col. F. G. Lescher. Second edition. Pp. xvi + 496. (London: Baillière, Tindall and Cox, 1940.) 15*s*.

IT is difficult, in these troublous and anxious days, to divert one's thoughts to any subject other than the ever-present War. Having listened to the wireless, read the daily paper and completed the daily duties, one desires to have mental relaxation with some form of light literature.

Consequently, when one takes up a book connected with the subject of war, one is rather prone to lay it aside with a feeling of distaste. The reviewer confesses that he experienced some such feeling when he recently took up the present volume written by Lieutenant-Colonel Nicholls with chapters by Air-Commodore Glynn and Colonel Laurie. First impressions are often fallacious and in this case proved to be markedly so. Having commenced to read the book, the chief difficulty was to put it down; one went on from page to page and, having attained the end of the final chapter, one's chief desire was to read the book again and grasp facts more thoroughly.

Tempora mutantur, nos et mutamur in illis; this is very certainly true with regard to the medical services of the Army. How vastly conditions have changed since the War of 1914–18. Changed in every way: mechanization of units, those of the medical services in common with other branches, new weapons, the immense increase in the air arm, the huge size of opposing forces, the speed with which they move and consequently the rapidly varying situation and the changing aspect of the battle from hour to hour. All these factors tend to an enormous increase in the number of casualties, and it is inevitable that the problems of collection, evacuation and treatment of the wounded are vastly more difficult than has ever previously been the case.

Another difficulty which presents itself in modern warfare is that a present-day campaign is not merely one of opposing military forces; the civilian populations have to be taken into consideration and the casualties among them may probably be very heavy. Coping with them, in addition to those of the fighting forces, will prove no easy matter.

Prior to the War of 1914–18 we were guided, in estimating the probable number of casualties, to a great extent by Cron's formula, but even then Cron's formula was found to be to a great extent fallacious and not to be relied upon, and this will be infinitely more so now. It is highly probable that, in the present War, we shall have to revise our ideas to an enormous extent.

The real essentials of successful medical organization in a modern campaign are elasticity, a power to appreciate rapidly changing situations, to make quick decisions and to acquire an ability to organize rapid—indeed instantaneous—improvization. The book under review brings these facts very forcibly to notice. The whole subject of evacuation from the front to the base is very thoroughly dealt with. The manifold duties of a regimental medical officer might perhaps have been more fully explained with advantage. Every battalion is not constantly in action and, important as are the duties of the regimental medical officer during actual fighting, yet during the periods of 'rest' (so-called) his duties are onerous and of great value to the unit to which he is attached.

It is laid down in Regulations that the first duty of the medical service is the preservation of health, the professional care of the sick and wounded coming second. While the actual responsibility for the preservation of the fitness of troops rests with the commander of those troops, it is the duty of the medical officer to watch matters carefully and to give judicious and timely advice to the commander as to what measures are advisable regarding preservation of health and how these measures had best be carried out. Such advice will be received and acted upon, in fact will frequently be eagerly solicited; the reverse is fortunately very much the exception.

If the regimental medical officer takes his duties really seriously, he will find that he is an extremely busy man even during a period of 'rest'. The closer the co-operation between the commander of a battalion, the adjutant and the medical officer, the better the health and fitness of the battalion will be.

The chapter on the casualty clearing station is very important and interesting; this unit is the first place in the line of evacuation in which actual hospital accommodation is provided and where full surgical treatment can be carried out. The casualty clearing station is really the pivot in the line of evacuation.

An extremely interesting section is that which deals with the transport of casualties by air and also with the many ways in which aircraft may be of inestimable service in the conveying of medical personnel, supplies, etc., both in peace-time and in war. A striking instance of this is that of the 'flying doctor' service in Northern Queensland and other parts of Australia. Anyone who is acquainted with this service is well aware of the untold benefits it has conferred on sick or injured people in out-of-the-way parts of the country. For example, a case of acute appendicitis may occur in an 'outback' station; the nearest surgeon is one hundred and fifty miles away, bad roads and flooded creeks intervening. A telephone message to the service headquarters will result in the very speedy advent of a surgeon, removal of the patient by aeroplane to hospital and operation, the whole procedure taking a few hours. Another example was furnished when the terrible earthquake occurred at Quetta a few years ago; a medical unit, a large number of medical officers and nurses, more than half a ton of medical stores and food, and about two tons of clothing were rapidly conveyed to Quetta by aeroplanes from Peshawar, Ambala, Karachi and other stations; the benefit was incalculable. These are but two examples of the value of the air service in medical work; the present War will doubtless furnish many more.

A point which has been wisely stressed is that of the precautions which are necessary with regard to the storage and use of radium in war-time. Naked radium might be liberated as a result of high-explosive action, and the consequent results might be extremely serious; the practical precautions which should be taken in order to avoid such risks are clearly and practically indicated.

Part IV is devoted to the "Emergency Medical Service". This section will be of very great value, not only to medical officers of the fighting services, but also to civilian medical men and women throughout the country. The present War is a 'peoples' war' and affects everyone; civilian casualties may quite possibly be immense in number and severity, and dealing with them will present a problem which will tax the resources of all medical and nursing personnel, civil and military. Casualties in bombed cities and towns will require rapid collection, treatment and removal to hospital; the selection of the most suitable site for a 'casualty hospital' for such cases will be no easy matter. Trueta, who had very considerable experience of air raids in Barcelona and elsewhere, points out that these hospitals are often from necessity in a vulnerable area, and perhaps the safest are those in districts with modern anti-aircraft defences, such as balloon barrages, anti-aircraft guns, etc.

This book which we have been considering has been written by Army men for Army men, and the information which it contains should conduce to the efficient medical treatment and welfare of the soldier. Presumably the present War will be followed, as was the last, by a spate of post-War literature. After the War of 1914–18, many books of reminiscences and numerous novels were written; some of these were of real interest and presented a true picture of the lives of officers and soldiers in war-time. Other books (fortunately in the minority) were simply abominable and portrayed the British soldier in utterly false colours. The present reviewer, in setting forth his very definite and positive views regarding the British soldier, feels quite satisfied that he is stating nothing but the simple unvarnished truth—truth which nobody with real knowledge can controvert—and his opinions are the result of a life-time's experience. The term 'British soldier' does not here refer only to the men of these islands; it is intended to include soldiers of the British Commonwealth all over the world—Canadians, Australians, New Zealanders, South Africans, Indians and many others. With all of these the reviewer has served, he has worked with them and played with them, and without a shadow of doubt or hesitation he feels most strongly that there are no finer men in the whole world than the fighting men of our Empire, brave, cheery, patient in suffering, steadfast in adversity, loyal and big-hearted.

Such men deserve the very best we can give them and the very utmost we can do for them. Believing all this, the reviewer cannot but feel deeply resentful and angry when he reads articles or books in which the soldier is sneered at or vilified by authors who probably have but little real knowledge or experience of him, who do not understand his life, his trials, hardships and suffering, and who themselves could scarcely hope to attain to his standard of courage, endurance and self-sacrifice.

Few branches of the Army have the privilege and honour of being able to do more for the welfare of the rank and file than have the Army Medical Service; this Service has done much for the soldier in the past and will do even more in the future. It is evident that the writers of the book under review have the interests of the British soldier at heart; it is also very evident that they have studied carefully the many and difficult problems of medical organization and administration in war. The book is the result of hard work and careful study, and will be of great assistance not only to officers of the medical service of the Army, but also to the many thousands of physicians and surgeons who in the onerous days ahead will be engaged in war work.

HISTORY AND SCIENCE

History and Science
A Study of the Relation of Historical and Theoretical Knowledge. By Hugh Miller. Pp. xi+ 201. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 12*s*. net.

THIS is a valuable and interesting, though somewhat difficult, book of which the avowed purpose, as we are told on the cover, is to "free empirical science from the ghosts of the rationalistic past which still haunt and mislead its progress". It is well worth reading for the variety of thoughts which it expresses, although one is bound to say at the end that the solution offered is not as clear as the apprehension of the difficulties which surround its approach.

The author explains his theme in a short biographical introduction in which he says that from the earliest years he has been perplexed by the opposition of the two sorts of thinking which are constantly presented to our minds; one he calls theoretical science and the other historical science. (One must note, by the way, that his habitual use of the word 'theoretical' in this restricted sense rather adds to the difficulty of reading his book.) But the main gist and purpose are clear enough. We have on one side a body, let us say, of conclusions or doctrines of which mathematics seems to be the most perfect, which stand firm and rise above the tide of historical change. Thus the equality of two and two to four is apparently a fixed and unalterable truth (the author would say a 'theory'). On the other side we have the constantly changing facts of organic life, of which he ascribes the discovery rather too exclusively to Darwin. Man is the highest product of these, and we have to assume that the mind of man which is his highest—or at least most peculiar—feature has also changed through the ages. How then are we to reconcile the eternity and permanence of what he calls "theoretical science" with the infinite change and growth of the organic side of the universe which is best represented to us in man? It is a pretty problem, and Prof. Hugh Miller follows it through three books and twelve chapters with great persistency and a good deal of enlightenment. He cites numerous philosophers from the earlier Greeks down to Bergson and, if it were not for a confession of faith in the preface, one would be inclined to say that the historical or changeful side of thought wins all the way. In fact the closing words of the last chapter are a moving appeal to history. "Action is our last honesty. Let us act—we have surmised enough—and show what our hearts are bent upon. Let us allow the appeal to history and in the name of history, fight".

This appeal goes home to the heart of the present reviewer, who has always held that history—especially the history of science—was the most important part of intellectual progress and should be made a leading feature in our educational courses. Science has grown and is constantly changing and we—outside Nazi Germany—are trying to keep pace with it. In that sense above all we would echo the eloquent epilogue of Prof. Miller and "in the name of history, fight".

Yet one cannot turn one's back on all the great conclusions of the thinkers of the past; one must still believe that two and two make four, even though our earliest ancestor may have thought the same thing. The answer to the whole dilemma is clearly a compromise, as the author indicates in his preface. There are certain constant structures of fact and thought which stand firm throughout the evolutionary process. Just as every animal form needs some food to sustain it, so it is constantly true that two and two make four. On these and a good many other permanent truths the mind feeds and grows.

We have in the present state of knowledge a long perspective of the past evolution of life which has given us an entirely new orientation towards history. All life is history, and this historical life has from the first and throughout a basis of non-evolutionary science. The living side now includes geology; it cannot be said to include either physics or astronomy, although we are always on the track of some evolutionary explanation of the heavenly bodies. Mathematics, however, in its foundations appears unaffected by the changes of organic life. Man discovers transcendental numbers but he does not create them. The mathematical foundation of our universe of knowledge appears to come from a distinct source from that of life. Is it—as Sir James Jeans has suggested—that God, as the mathematician, has working with him a co-adjutor or another side of His being which comes to its highest force in men's minds? The mathematical foundations remain secure while life develops in infinite richness of variety.

It is these and similar thrilling questions which Prof. Hugh Miller raises in his thoughtful book.

F. S. MARVIN.

ANIMAL BEHAVIOUR

(1) Die tierischen Instinkte und ihr Umbau durch Erfahrung

Eine Einführung in die allgemeine Tierpsychologie. Von J. A. Bierens de Haan. Pp. xi + 478. (Leiden: E. J. Brill, Ltd., 1940.) 8 guilders.

(2) Animal Behaviour

Impulse, Intelligence, Instinct. By Dr. Johann A. Loeser. Pp. x + 178. (London: Macmillan and Co., Ltd., 1940.) 10*s.* 6*d.* net.

(1) DR. BIERENS DE HAAN'S book is well described by its extended title; it surveys the whole field of instinctive behaviour and its modification through learning, and constitutes an admirable introduction to the study of animal psychology. It is, as the author claims, the first general treatise on animal behaviour to be written from a purely psychological point of view. Dr. Bierens de Haan holds that the true science of animal psychology begins where behaviourism in its various forms leaves off; the facts of behaviour require interpretation in terms of the animal's subjective experience, in terms of knowing, striving and feeling, at least in their elementary forms. That instinctive behaviour is rooted in life, and cannot be understood without reference to the normal ecological conditions of the species the author freely admits; but he has concentrated his attention mainly on the psychological aspects of animal behaviour. That is the special key-note of the book. It is appropriately dedicated to the late Prof. Wm. McDougall, whose hormic point of view he shares.

Dr. Bierens de Haan, whose laboratory is in the Zoological Gardens at Amsterdam, is, of course, well known in Great Britain as a leading worker in the field of animal psychology, and he has made us all his debtors in providing this up-to-date survey of the subject. Great progress has been made of recent years, especially on the Continent, in the study of animal behaviour, and there is real need for a book like this which brings the facts together and indicates what they mean. With its full bibliography of thirty-five pages, and its three indexes, the book will be extremely useful, and indeed indispensable, to the serious student, and must find a place in his library.

A good half of the book deals with instinctive behaviour, and especially the simpler forms of it, which the physiologically minded call taxes and tropisms. While no attempt is made to cover the whole immense field, the numerous examples chosen from the modern work on the subject are highly interesting and instructive, and there is no better treatment of the general subject extant.

Like McDougall, Bierens de Haan draws a distinction between instinct and instinctive behaviour, defining the first in purely psychological terms. His definition (p. 34) closely resembles the well-known one proposed by McDougall—"an inherited or innate psycho-physical disposition which determines its possessor to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a particular quality upon perceiving such an object, and to act in regard to it in a particular manner, or, at least, to experience an impulse to such action". Bierens de Haan's definition is somewhat fuller, and brings out the important point that specific perceptions and feelings may also be aroused by specific drives. While instinct is a purely psychological activity, instinctive behaviour is also a biological phenomenon, showing characteristics which require definition in biological terms. In particular, instinctive behaviour is usually purposive in a biological, but not in a psychological, sense—the animal acts instinctively, in normal conditions, in a biologically adequate way, but without knowledge of the end pursued; it "knows how" to act, but not why it acts; as Spaier has well said, it shows "savoir-faire" but not "connaissance".

In the second part of the book, the effect of experience and learning in modifying behaviour is fully and adequately discussed, in the light of modern work and the author's own extensive researches in this field. Here the important point is made that the role of learning and intelligence is secondary, that the instincts remain the essential factors in behaviour, though extended, modified and illumined by intelligence, Special attention is given to the higher forms of animal intelligence, where the animal shows what Bierens de Haan describes as a "concrete understanding" of spatial and causal relations.

(2) Dr. Loeser's book falls into a different class. In it he gives expression, in a popular way, to a particular view about instinct, which he published in a more technical form in 1931 (not 1939, as stated in the foreword) under the title "Die psychologische Autonomie des organischen Handelns". The circumstances in which this English version came to be issued are sympathetically explained in the foreword by Mr. L. J. F. Brimble, who has well carried out the arduous

task of preparing the book for publication after the tragic death of the author while a refugee in Great Britain.

Dr. Loeser would have us give up the notion of instinct altogether, and substitute for it that of small voluntary acts, strung upon a base of biological purposiveness or adaptedness, which he assumes to be given by the physical constitution of the animal. "Each 'instinct'," he writes, "such as bird migration, the honeycomb-building of the social Hymenoptera or their complicated system of caring for their young, can be divided up into a number of 'small' voluntary actions. These 'small actions', combined with a specific physical constitution, which becomes effective in the animal's natural surroundings, unite to produce *one* biologically purposive action" (p. 174). There is no rigid and automatic connexion between impulse and reaction ; in any given situation the animal does the best it can, according to the "pleasure principle". From this point of view Loeser attempts to explain, or explain away, many of the classical examples of instinctive behaviour, as, for example, nest-building in birds' migration, egg-laying and care of young. Most people will find his interpretations rather far-fetched and unconvincing. In biological matters he is not a wholly reliable guide ; there are too many sweeping general statements of doubtful accuracy. He writes as a psychologist, and is not free on occasions from the error of anthropomorphism.

The book has, however, its merits, and it deserves to be read for the unconventional and provocative nature of the views expressed. Loeser is undoubtedly right in emphasizing the psychological character of instinctive behaviour, in refusing to treat such behaviour as mechanistic or rigidly determined ; he is right also in stressing the simplicity and proneness to error of the psychological processes involved ; but he fails to see that the biological adaptedness or purposiveness of instinctive behaviour lies in the instinctive impulses themselves, as part of the inherited psycho-physical constitution of the animal.

E. S. RUSSELL.

POTASSIUM COMPOUNDS

Gmelin's Handbuch der anorganischen Chemie
Achte vollig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 22 : Kalium, Lief. 6, Schluss der Verbindung. Pp. 1075–1230. 21–75 gold marks. Lief. 7 : Techniche Darstelling der Kalisalze. Pp. 1231–1338. 16.50 gold marks. (Berlin : Verlag Chemie, G.m.b.H., 1938–39.)

PART 6 of the volume on potassium in "Gmelin's Handbuch" terminates the account of its compounds and deals chiefly with such compounds as contain also either lithium or sodium. Whereas the chlorides of lithium and potassium give merely a eutectic mixture, the system between the two sulphates is complicated by the fact that each of the two latter is dimorphous. A liquid alloy of sodium and potassium was known to Sir Humphry Davy. The compound NaK has not been isolated, but its existence is inferred from its band spectrum. It is chemically more active than either of the two metals.

Phase-rule studies of various combinations of salts of potassium and sodium, including the tartrate, are described. Particular attention is devoted to Rochelle salt on account of its remarkable properties, the most outstanding of which are its marked piezo-electric effect and the anomalous dielectric properties in the direction of the crystallographic a-axis. The two properties are closely inter-related, but the anomalies disappear not only above 24° C. but also below $-18°$ C.

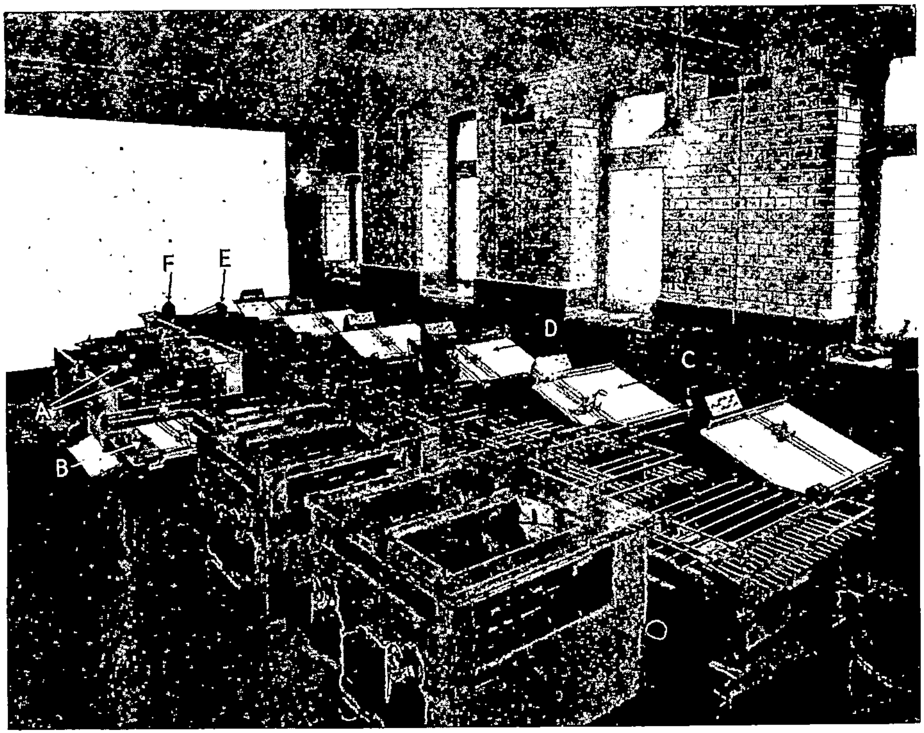
Part 7 contains details of technical processes in the production of potassium salts. It is just a hundred years since boring was first undertaken at Stassfurt with the object of finding the origin of certain natural brine supplies. The importance of the rock salt which was discovered was not at first realized owing to the presence in it of 'undesirable' potassium and magnesium salts, and many years elapsed before the potash industry was established. A three-page table shows the gradual development of the industry in various countries between 1861 and 1936.

After the War of 1914–18 the important deposits in Alsace passed into the possession of France and other sources have been discovered in Poland, Spain and America. An international agreement was reached in 1925 for the regulation of production and supplies. An account is also given of many other technical processes such as the extraction of potassium salts from seaweed, from sea water and from the waters of certain inland seas, and of the separation of potassium chloride from carnallite and also of potassium salts from borax.

THE BUSH DIFFERENTIAL ANALYSER AND ITS APPLICATIONS*

By Prof. D. R. Hartree, F.R.S.,
University of Manchester

IN the application of mathematics to problems both of pure and applied science, there often arise differential equations which have no formal solution, or none convenient for numerical evaluation, but for which numerical values of the solutions are required. Though there are numerical methods of dealing with such situations, it would often be advantageous, as an alternative, to have mechanical means of evaluating solutions of differential equations, and this is the purpose of the 'differential analyser' of Dr. V. Bush, of the Massachusetts Institute of Technology.



[*By courtesy of the Institute of Electrical Engineers*

Fig. 1.

General view of differential analyser at the University of Manchester. Photo by Metropolitan-Vickers Electric Co. Ltd.

The general idea of a machine for evaluating the solutions of differential equations is not new. Integrating mechanisms have been known for more than a hundred years, and the idea of connecting several such mechanisms together, in such a way that the combination of them would evaluate solutions of differential equations, was stated clearly by Kelvin[1] in 1876. But the whole credit for designing a machine which could be constructed in practice, and which would work accurately when built, must be given to Dr. V. Bush and his team at the Massachusetts Institute of Technology, where the first such machine was built about ten years ago[2]. The first machine of this kind in operation outside the United States was the one, with which I have been closely connected, at the University of Manchester (Fig. 1). This machine was built by the Metropolitan-Vickers Electrical Co., Ltd., and I must acknowledge the generosity of the late Sir Robert McDougall, who defrayed the cost of the machine to the University, and the friendly help I have had from Dr. Bush himself and from Dr. A. P. M. Fleming and all those members of the Research Department of Metropolitan-Vickers who have been engaged on its design, construction, installation and maintenance. Without the help, in various forms, which I have had from these sources, the installation of this machine would not have been possible. Through the interest of Prof. J. E. Lennard-Jones a second such machine, also built by Metropolitan-Vickers and including improvements in detail suggested by our experience at Manchester, is in operation also in this country, at Cambridge. There are now, so far as I know, altogether seven or eight full-size machines in operation in the world. There are also, in Great Britain, several smaller and less accurate model versions of the machine, of which the first was built, originally for demonstration and instruction purposes, by Dr. A. Porter and myself[3].

---

* From a Friday evening discourse at the Royal Institution delivered on May 17.

GENERAL IDEA OF DIFFERENTIAL ANALYSER

The differential analyser consists of a number of units, each of which can carry out one of the operations which may be involved in the mechanical solution of a differential equation. The essential units are the integrating mechanisms, each of which is a precision form of continuously variable gear. There are eight of these, in cases in pairs (Fig. 1, *A*). These can be interconnected in various ways, either directly or through other units of the machine, by shafts and gearing. There are two sets of shafts; cross-shafts driving or driven by the various units of the machine, and longitudinal shafts by which connexions are made between different units. Each shaft represents one of the quantities occurring in the equation; the rotation of the shaft measures, on a chosen scale, the magnitude of that quantity.

It is often necessary to supply to the machine information concerning a relation between two of the quantities occurring in the equation under investigation; for example, in calculating the scattering of electrons by an atom, it is necessary to supply the machine with the relation between the potential of the atomic field and the distance from the centre of the atom. This is done from an input table (Fig. 1, *C*), of which there are six. A graph, expressing the relation to be supplied to the machine, is drawn beforehand and placed on one of the tables, and is followed by an operator as the solution proceeds.

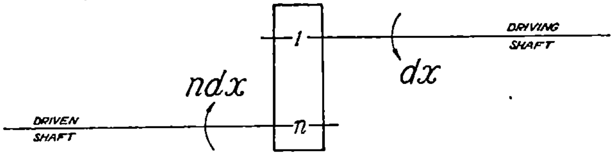


Fig. 2.

CONTINUOUSLY VARIABLE GEAR AS INTEGRATOR.

There are also means of recording the solution either in the form of a graph on an output table (Fig. 1, *B*), or numerically by recording the readings of a set of revolution counters (Fig. 1, *E*).

INTEGRATORS

Any continuously variable gear will serve as an integrating mechanism (Fig. 2). Let a driving and driven shaft be connected by any mechanism such that the driven shaft runs n times as fast as the driving shaft; then for a small rotation dx of the driving shaft, the rotation of the driven shaft is ndx, so that if the gear ratio n is varying as the driving shaft is rotating, the total rotation of the driven shaft is $\int ndx$. For the present purpose we require a form of continuously variable gear which can be set accurately to any gear ratio n within its range, and this range must include zero and negative values of n without any mechanical difficulty. A convenient form (Fig. 3) consists of a wheel the plane of which is fixed, driven by the rotation of a disk of which the axis is carried in a carriage so that the distance of the wheel from the centre of the disk can be varied. Alteration of this distance alters the gear ratio between the shaft driving the disk and that driven by the wheel, and the gear ratio is proportional to the displacement of the disk from its central position.

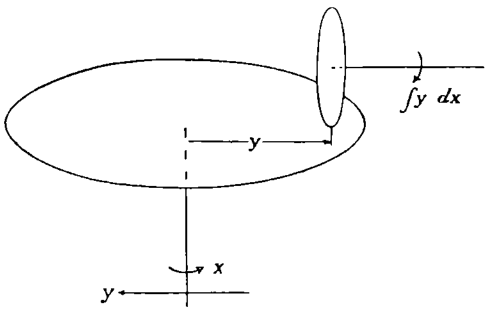


Fig. 3.

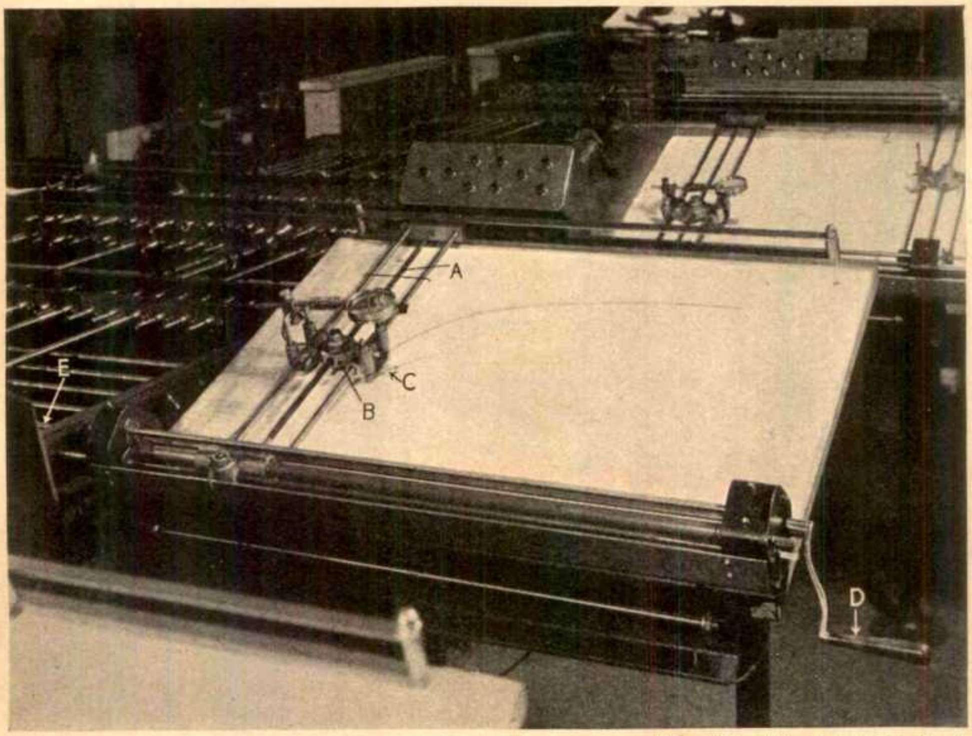
PRINCIPLE OF THE INTEGRATOR.

Each integrator is provided with a servo mechanism, by which the driven shaft is made to rotate at the same speed as the integrating wheel, but with greatly increased turning force or 'torque', whence the name 'torque amplifier'. The principle in which this operates is much the same as that of the capstan. The shaft carrying the integrating wheel and the shaft to be driven are fitted with arms, which are connected by bands running over two drums driven in opposite directions by a motor. When the integrating wheel starts to turn, one band tightens and the other loosens; the tightening of the one band increases the friction between it and drum; this tightens it further, so that the tension builds up exponentially along the band, and the driven shaft is pulled round with a much greater force than that applied by the input arm. In effect, the rotation of the integrating wheel does not directly drive the output shaft, but controls the supply of power to it from the motor driving the torque amplifier drums.

INPUT AND OUTPUT TABLES

Each input table (Fig. 4) consists of a bridge (*A*) spanning the table, the bridge being movable perpendicular to its length and supporting a carriage (*B*) which can be moved along it by the rotation of a handle (*D*), and the carriage carries a pointer (*C*). The table carries a graph, drawn beforehand, expressing the information to be fed to the machine. The bridge is moved along the table by the operation of the machine, and as it moves over the graph, an operator turns the handle so as to keep the pointer on the curve. The handle also drives one of the cross shafts (*E*) of the machine, from which the information expressed by the graph can be fed into the machine wherever required. It is possible to replace the human operator by an automatic curve follower operated by a photo-cell; one such has been built by Hazen[4] at the Massachusetts Institute of Technology, and another working on a different principle suggested by Blackett and developed by F. C. Williams[5] has been tried successfully in an experimental form at Manchester.

Occasionally, if a quantity is varying with time, its rate of change at any moment may depend not only on its value at that moment, but also on the value it had at some previous time. To deal with such a situation a special input table can be used; this has two bridges, one carrying a pencil and the other a pointer. Both bridges move along the table, with an interval between the pencil and pointer. The pencil draws a curve and after an interval the information expressed by this curve is fed back to the machine by an operator who keeps the pointer on the curve already drawn by the pencil. This unit (Fig. 1, *D*) was first developed at Manchester in connexion with some work on the effect of time lag on automatic temperature control in industrial plant[6].

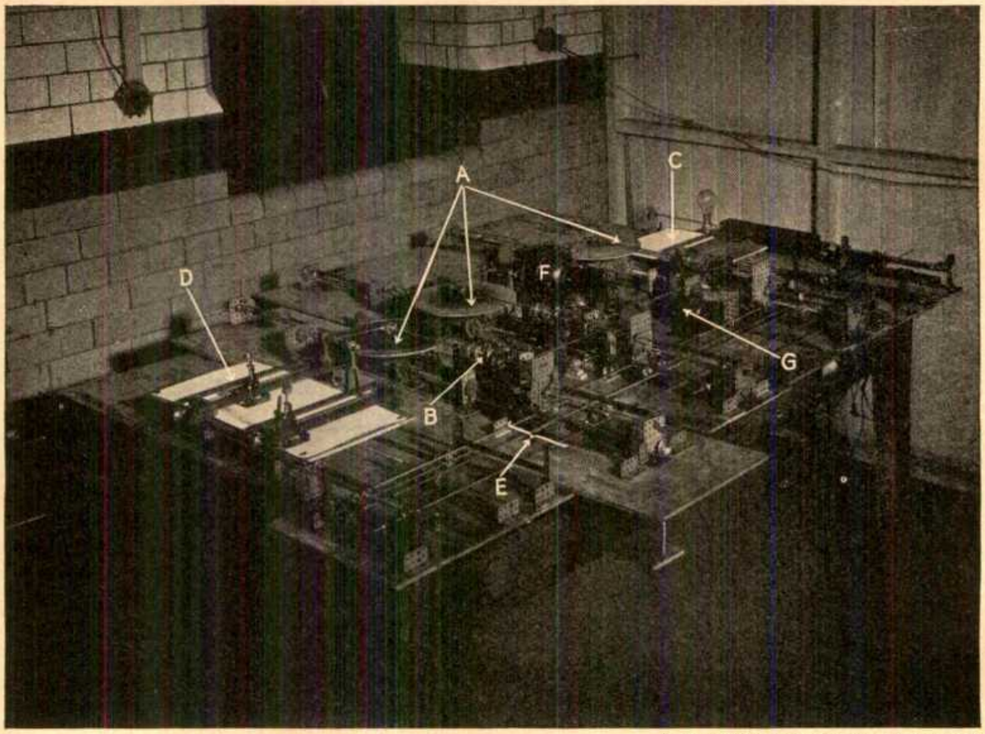


[*By courtesy of the Mathematical Gazette*

Fig. 4.

INPUT TABLE. PHOTO BY METROPOLITAN-VICKERS ELECTRIC CO. LTD.

The output table is similar to an input table, but in place of the pointer of an input table which is kept on a curve by an operator, there are two pencils which are moved along the bridge by the machine, so that graphs of two quantities occurring in the equation can be recorded simultaneously. Sometimes such a graphical record of the solution is the most convenient form of result, but when accurate numerical values are required, it is better to record the results directly in numerical form. This can be done by having a set of counters driven by the machine, and recording their readings either by a printing mechanism or photographically by a camera (Fig. 1, *F*).



[*By courtesy of the Mathematical Gazette*

Fig. 5.

MODEL DIFFERENTIAL ANALYSER AT THE UNIVERSITY OF MANCHESTER, MAINLY CONSTRUCTED FROM STANDARD MECCANO PARTS. PHOTO BY GUTTENBERG.

A. Integrators. *B*. Torque amplifier. *C*. Input table. *D*. Output table. *E*. Longitudinal shafts. *F*. Motor driving torque amplifiers. *G*. Motor driving independent variable shaft.

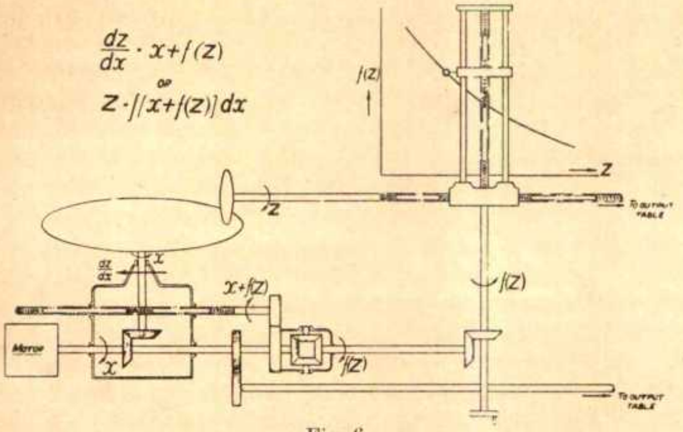


Fig. 6.

APPLICATION OF INTEGRATOR TO A SIMPLE EQUATION.

OTHER UNITS

There are various accessory mechanisms: adding units each of which is similar to the differential gear of a motor-car, epicyclic gear trains for compensating backlash which are therefore called 'frontlash' units, and gear wheels for connecting the various shafts. The longitudinal and cross-shafts are connected by cross-drives, each formed by a pair of helical gear wheels. By these, any longitudinal shaft can be connected to any cross-shaft. The great variety of different inter-connexions of the units of the machine thus made possible is the secret of the very wide range of equations to which it can be applied.

SMALL-SCALE MODELS

The first photographs I saw of Dr. Bush's machine gave me the feeling that someone had been enjoying himself with a super-Meccano set, and this gave me the idea of trying to build, so far as possible from standard Meccano parts, a model to illustrate the principles of the machine.

This was originally done more for amusement than with any serious purpose, but the first results were successful beyond my expectations, and suggested that it would be practicable to build such a model to do serious work on problems for which high accuracy was not required in the results. Largely with the help of Dr. Porter, such a model was built, and proved successful for such work[3] (Fig. 5). It has also been useful for demonstration purposes, for trying in an experimental form new ideas such as the special input table.

USE OF THE MACHINE

As already explained, the quantities occurring in the equation are represented by the rotation of various shafts. These shafts have to be connected, through integrators and other units of the machine, so that the relation between their rotations is a translation into mechanical terms of the equation to be solved.

Consider, for example, the equation

$$\frac{dz}{dx} = x + f(z)$$

(Fig. 6). To see how the machine handles an equation, it is often best formally to integrate once, which in this case gives

$$z = \int [x + f(z)]\, dx.$$

This shows that, at any value of x, the integrand (that is to say, the displacement of the integrator) is made up of two contributions, one x itself, and the other depending in a definite way on the value which the integral z itself has reached. Suppose we can supply the integrator with such a displacement (how this is done will appear shortly) and suppose we rotate it by a drive from the shaft whose rotation represents x. Then the rotation of the integrating wheel will be z. Let a drive from this wheel be taken to displace the bridge of an input table on which is placed a graph of $f(z)$ against z. If an operator (or automatic curve follower) keeps a pointer on the curve, the rotation of the shaft driving the pointer measures the value of $f(z)$ (on a suitable scale and from a suitable zero). If we take a drive from this shaft and one from the x-shaft to an adding unit, the output from the adding unit will be $x + f(z)$, and this is just what we want to furnish to the integrator as a displacement. Thus if the adding unit is connected up to displace the integrator, then the rotation of the x-shaft, which is driven by a motor, will drive the rest of the mechanism in accordance with the equation. (The 'mechanism' here includes the operator who follows the curve.)

APPLICATIONS

This differential analyser handles a mathematical situation, namely, that expressed by a differential equation, without reference to the particular scientific or technical problem from which that situation arises. Such a situation does arise very frequently and in a very wide range of problems, and the range of application of the machine is correspondingly wide.

It has been applied[7] to calculations concerning: (1) Structure and some properties of atoms, molecules, and atomic nuclei; (2) at the other end of the scale of size, on structure and stability of stars; (3) paths of electrified particles in the field of a magnet (aurora and cosmic rays); (4) energy exchange between a gas and a solid; (5) some examples of fluid flow round solid bodies; (6) potential distributions in cylindrical valves, both of steady-state and for rapidly varying conditions; (7) a number of examples of currents in electrical circuits, and on transmission lines, involving elements with non-linear characteristics or time-varying impedances; (8) starting characteristics of synchronous motors; (9) effect of time lag on automatic control systems; (10) train running times; (11) temperature rise and distribution in insulating material in alternating fields.

In conclusion, there is one thing I want to emphasize about the differential analyser, namely this, that despite its range and its capabilities, it is no substitute for a study of the formal mathematical theory of differential equations. Necessarily it can only evaluate particular solutions of particular equations; whereas if a formal solution is available, it will usually give the general solution of a whole class of equations, which is much more extensive, and often much more useful, information. The differential analyser is only to be regarded as a last resort when the formal theory gives no useful results. But so often in practical problems the last resort is the only resort, and it is then that the machine shows its scope and power.

---

[1] Thomson, Sir W. (Lord Kelvin), *Proc. Roy. Soc.*, **24**, 269 (1876).

[2] Bush, V., *J. Franklin Inst.*, **212**, 447 (1931).

[3] Hartree, D. R., and Porter, A., *Mem. and Proc. Manchester Lit. and Phil. Soc.*, **79**, 51 (1935).

[4] Hazen, H. L., Jaeger, J. J., and Brown, G. S., *Rev. Sci. Inst.*, **7**, 353 (1936).

[5] Blackett, P. M. S., and Williams, F. C., *Proc. Camb. Phil. Soc.*, **35**, 494 (1939).

[6] Callender, A., and others, *Phil. Trans. Roy. Soc.*, A, **225**, 415 (1936); *Proc. Roy. Soc.*, A, **161**, 460 (1937).

[7] For detailed references to applications, and further references to the differential analyser, see Hartree, D. R., and Nuttall, A. K., *J. Inst. Elect. Eng.*, **83**, 643 (1938); Hartree, D. R., *Math. Gazette*, **22**, 342 (1938).

EVOLUTION OF THE GALAPAGOS FINCHES

By DAVID LACK,
DARTINGTON HALL, TOTNES

INTRODUCTION

THE land faunas of oceanic islands have always excited considerable evolutionary speculation, and, starting with the "Origin of Species", the Geospizinæ, the endemic Galapagos finches, have probably featured in as many evolutionary discussions as any group of animals. They differ from almost all other land birds of oceanic islands in that there is more than one species on each island. Further, some of the species seem to grade into each other, and others are linked by freak specimens. Some workers have supposed that some quite peculiar method of evolution must have been involved.

Assisted by grants from the Royal and Zoological Societies of London, I spent December 1938–April 1939 on the Galapagos investigating the breeding behaviour and ecology of the Geospizinæ, following this with a statistical study of museum material. Another object, to interbreed the different species, failed on the islands, but is being continued with captive birds brought to the California Academy of Sciences, San Francisco. The following is a brief summary of some general evolutionary problems. Full results will be published later[1] together with a list of the many persons who helped the expedition, the museum study, and in discussion.

SUBSPECIES

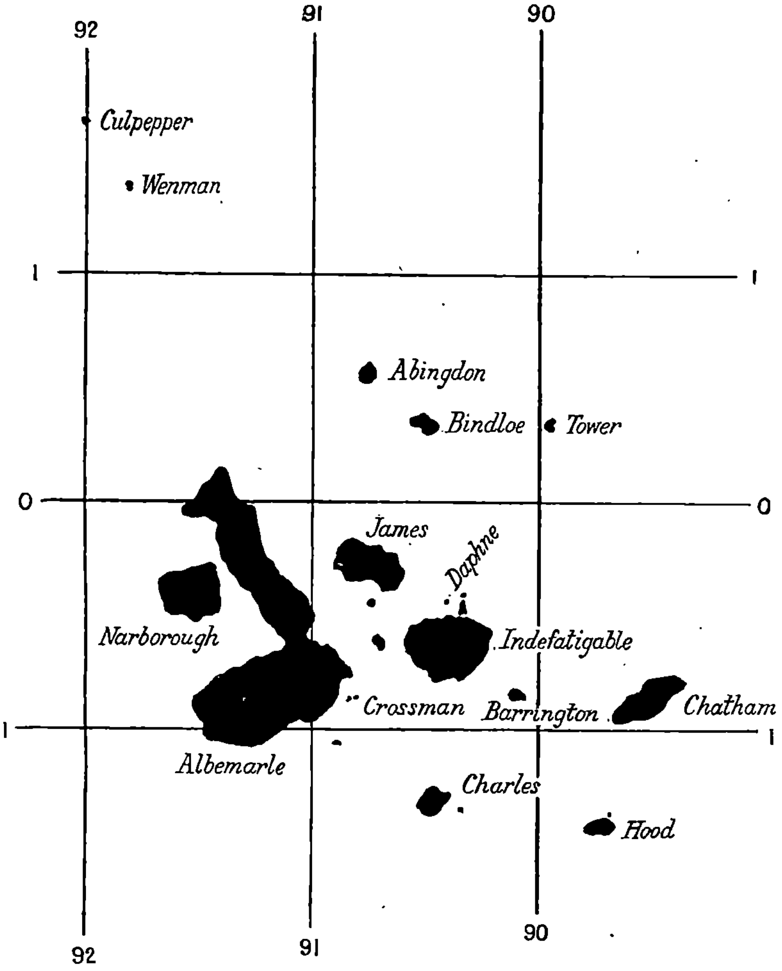
There are ten main species, each found on most of the islands. Some are divided into island subspecies, which differ mainly in beak size and minor plumage characters. The various Galapagos Islands present similar conditions for Geospizinæ, and no species show regular or parallel trends of variation on different islands. Hence I consider that isolation of small island populations has led to non-adaptive differentiation in the manner postulated by Sewall Wright[2]. That the two main factors in the formation of island subspecies are (1) degree of isolation (2) size of population, is indicated by the fact that small isolated islands have a higher proportion of endemic forms (also a smaller total of species) than have either small central islands or large isolated islands. Large isolated islands have a higher proportion of endemic forms than the central islands, large or small. Another point, the two most variable species, *Geospiza magnirostris* and *G. fortis*, are significantly less variable in three measured characters (namely, wing, culmen from nostril and depth of beak) on small isolated islands than they are on large or central islands. (This relation did not hold in four other less variable species.)

SPECIES

Geospiza magnirostris (large), *G. fortis* (medium size) and *G. fuliginosa* (small) are three closely related species which do not differ at all in plumage but solely in size and relative size of beak, and to some extent in song. The beak is the chief specific character, the larger species having relatively larger beaks. There is no allometric relation between beak and body size within each species, but the ratio is too subject to individual variation to form a reliable specific character. These three species occur together in the same habitat on many islands, the food and feeding habits of the first two seem identical, and of *G. fuliginosa* closely similar, and they use similar nest sites. On some, but not all, islands *G. fortis* is so variable that the smallest individuals appear more like large *G. fuliginosa* than like the largest individuals of their own species, and the latter appear more like small *G. magnirostris* than like the smallest individuals of their own species. (There is no evidence for selective mating by body and beak size within *G. fortis*.) Yet normally the three species keep distinct, and on most islands there is no evidence for hybridization, though this cannot be completely ruled out. There is a small overlap between the species in all characters, but nearly all specimens can be safely identified. However, a few specimens are intermediate in several characters together and cannot be safely allocated.

Field study showed no adaptive significance for the inter-specific beak differences *except* that they are the major (but probably not the sole) factor in specific recognition. A male usually attacks a rival by gripping its beak; frequently a male started to chase a member of a different species from behind, but usually, though not always, it stopped on coming round in front where its beak was visible. Experiments with wild birds which attacked and courted stuffed specimens confirmed the use of the beak in specific recognition.

Camarhynchus psittacula (large) and *C. parvulus* (small) occur together on most islands and present a similar problem to the Geospiza species, while on one island occurs a third species, *C. pauper*, differing from *C. psittacula* solely in a smaller depth of beak and in minor plumage details. In general, the closely related species of Geospizinæ are not usually separated by habitat, nest site, breeding season or any other geological factor. Geneticists seem agreed that isolation promotes inter-sterility, and I consider that these species have evolved via geographically isolated subspecies which later met on the same island and did not interbreed. The species differ from each other in the same characters which distinguish island subspecies, that is, in beak and sometimes in minor plumage characters. When beak differences assist in specific recognition, they will be intensified by selection quite apart from their relation to feeding habits, since hybridization is at a selective disadvantage. It is extremely difficult to see any other significance for the specific beak differences, or to understand why, otherwise, they should persist. But the highly variable *G. fortis* still presents great difficulties in interpretation.



The Galapagos Islands.

In two cases, the origin of a species via a geographical form seems clear. The *Camarhynchus psittacula* group is represented by one form on each main island except on Charles where two occur, *C. psittacula* and *C. pauper*. *C. pauper* was probably derived from the *psittacula* group via the form *affinis* on Albemarle to the west, as they are rather similar. *C. psittacula* on Charles is almost indistinguishable from *C. psittacula* on Indefatigable to the north, and probably colonized Charles from Indefatigable more recently, met *C. pauper* but kept distinct. Again, *G. fuliginosa* occurs on all the main Galapagos Islands except Tower in the north-east, where a rather similar species *G. difficilis* (formerly *acutirostris*) is found, which could have been derived from *G. fuliginosa* from Chatham to the south, and would probably have been classified as a subspecies of *fuliginosa*, but that it also occurs on Abingdon, to the west of Tower, together with a small form of *G. fuliginosa*, from which it keeps segregated.

Rensch[3] considers that, in general, most bird species have evolved via geographically isolated subspecies.

HYBRIDIZATION

Lowe[4] regarded hybridization as the main factor in species-formation in the Geospizinæ. The amount of hybridization has been greatly exaggerated. We saw no certain cases in the field. The occasional freak and intermediate specimens are not necessarily hybrids, and in any event have probably played little, if any, part in speciation. Hybridization may sometimes have occurred between two differentiated island subspecies of the same species which later met on the same island, but this is much more likely to result in a variable form of the same species than in a new species. However, in two cases a species-hybrid seems to have become established. On Culpepper in the extreme north occurs the highly variable *Geospiza conirostris darwini*, which shares characters of *G. magnirostris* (widespread on other islands) and *G. conirostris propinqua* (on Tower) and is probably of hybrid origin between these two. On the tiny islets of Daphne and Crossman (which are not near each other) occurs a highly variable Geospiza species intermediate in characters between *G. fortis* and

G. fuliginosa, and overlapping with both. Presumably it is of hybrid origin ; if so, here is the unusual case of two species which occur together over most of their range without interbreeding but which interbreed in two small isolated localities.

ADAPTIVE RADIATION

Island forms differ in non-adaptive characters and give rise to species which differ mainly in non-adaptive characters except in so far as these are recognitional. But, at a later stage, pronounced adaptive characters appear, and the main genera of Geospizinæ represent a minor adaptive radiation. *Geospiza scandens* is at an intermediate stage. It uses its long thin beak for feeding in Opuntia flowers, but these are seasonal, and much of its diet resembles that of other Geospiza species, which have finch-like beaks and eat mainly seeds. *Platyspiza crassirostris* eats mainly leaves. Camarhynchus species have beaks rather similar to Platyspiza, but eat mainly insects. *Cactospiza pallida*, clearly derived from Camarhynchus, has evolved in the direction of a woodpecker in both habits and beak. It also has the unique habit of holding a small twig or Opuntia spine lengthwise in its beak and probing insects out of cracks in trees, dropping this tool to seize the insect as it emerges. *Certhidea olivacea* is like a warbler in both beak and feeding habits. Despite their dissimilar feeding habits and appearance, all these forms have extremely similar breeding behaviour, which confirms previous anatomical findings as to their close relationship to each other.

EVOLUTIONARY FACTORS

The three main factors in the evolution of the Geospizinæ have probably been : (1) The almost complete absence of food competitors. A few other land birds now frequent the islands, but all except Nesomimus are so little differentiated from mainland forms that they probably colonized long after the ancestral Geospizid arrived. (2) The almost complete absence of predators. Worthington[5] shows the marked inhibitory influence of predators on adaptive radiation.

These two factors result from the extreme isolation of the Galapagos and the difficulty of colonization for birds. Both must diminish the intensity of selection.

(3) Equally important, the opportunities for temporary isolation of different forms provided by the existence of a number of islands. One species of Geospizid, *Pinaroloxias inornata*, occurs outside the Galapagos, on the extremely isolated island of Cocos, and is so differentiated that it has clearly been isolated a long time, but there is only one island and still only one species of Geospizid. In general, no bird groups have evolved similarly to the Geospizinæ on solitary islands, however isolated, but two parallel cases occur in isolated archipelagos. The two species of endemic finch, Nesospiza, in the Tristan da Cunha Islands differ primarily in beak[6], so here is Galapagos in miniature, and at the other extreme is the marvellous adaptive radiation of the Drepanididæ in the Hawaiian group[7].

SECONDARY SEXUAL PLUMAGE

In Geospiza species the adult male plumage is black, but individuals frequently breed in the grey-brown juvenal plumage, or in partly black and partly juvenal plumage. In Platyspiza and Camarhynchus, the 'full' male plumage is partly black, and many individuals breed in juvenal plumage, the percentage greatly varying on different islands. In Cactospiza, the male is normally coloured like the juvenal, but one had a black head. This tendency to lose the male secondary sexual plumage occurs in many other land birds of oceanic islands. Such plumage is usually considered to have evolved through purely intra-specific selection, through threat and courtship display, and one would suppose threat and courtship were as essential on oceanic islands as elsewhere (Geospizinæ display vigorously). But there is a further function of such plumage which has relation to other species, namely, enabling the female to recognize and pair up with a male of her own species, hybridization being at a selective disadvantage. The few land birds which have colonized oceanic islands are normally removed from all related species which the female might possibly confuse with her own, so this function disappears. The opposite of this process is seen in some continental Gallinaceous birds, and some birds of paradise, in which the sexes meet only for copulation and there is not the complex inter-related pairing behaviour typical of birds in which both sexes raise the young. Probably correlated with this, hybridization is relatively common, and at the same time there is an extreme development of male secondary sexual plumage, each species being strikingly distinct.

To sum up, while the Geospizinæ present certain unusual features, there is no need to postulate some quite peculiar evolutionary agency. As on other oceanic islands, the almost complete absence of food competitors and predators has decreased the intensity of selection, so that peculiar types or habits have a greater chance of persisting. The existence of a number of islands has promoted non-adaptive differentiation of island subspecies, from which species have been evolved when two such forms have later met in the same area and kept distinct. The genera show a minor adaptive radiation. The loss of male secondary sexual plumage is correlated with its ceasing to function in specific recognition.

[1] Lack, D., "The Galapagos Finches (Geospizinæ): a Study in Variation", *Proc. Cal. Acad. Sci.* (in the press).

[2] Wright, Sewall, "Evolution in Mendelian Populations", *Genetics*, **16**, 97–159 (1931).

[3] Rensch, B., "Zoologische Systematik und Artbildungsproblem", *Verh. deutsch. Zool. Ges.*, **35**, 19–83 (Zool. Anzeiger 6 suppl.) (1933).

[4] Lowe, P. R., "The Finches of the Galapagos in Relation to Darwin's Conception of Species", *Ibis*, 310–321 (1936).

[5] Worthington E. B., "On the Evolution of Fish in the Great Lakes of Africa", *Int. Rev. Hydrobiol. Hydrogr.*, **35**, 304–17 (1937).

[6] Lowe, P. R., "Notes on some Land Birds of the Tristan da Cunha Group collected by the Quest Expedition", *Ibis*, 519–523 (1923).

[7] Perkins, R. C. L., "Fauna Hawaiiensis", vol. 1, Pt. 4; Aves 368–466 (1903).

OBITUARY

Sir Oliver Lodge, F.R.S.

By the passing of Oliver Joseph Lodge the world has lost not only one of its most distinguished scientific investigators, but also one who had unique powers of exposition able to make clear to minds of less ability than his own the nature of new scientific discoveries or novel scientific conceptions in lucid and original language.

Lodge was born at Penkhull near Stoke-on-Trent on June 12, 1851, where his father had a business connected with the pottery trade. His school education was gained at Newport, Staffs, and it was intended that he should enter his father's business, which he did for a short time at fourteen years of age. But he soon exhibited a keen interest in science and disinclination for a business career. By private study he acquired sufficient knowledge to matriculate in the University of London and then to pass the intermediate examination for the B.Sc. degree.

At that time the Science and Art Department had a scheme for giving promising students and elementary science teachers an opportunity of gaining practical laboratory training under distinguished men, and the science schools at South Kensington had been opened for that purpose in 1872 with Edward Frankland as professor of chemistry, Frederick Guthrie for physics and Thomas H. Huxley for biology. Both Lodge and I took advantage of this opportunity and thus commenced a life-long friendship. We were both more interested in physics than in pure chemistry. Crookes had then begun, and was continuing, his researches on electric discharge in high vacua. Clerk Maxwell published in 1873 his great treatise on electricity and magnetism and had translated into mathematical form Faraday's original ideas concerning the electromagnetic field. We were both extremely interested in Maxwell's conceptions on electromagnetic waves. To gain additional knowledge of physics and mathematics Lodge entered University College, London, to study under Carey Foster in physics and mathematics with Henrici, but his abilities soon enabled him to pass from the state of student to that of teacher. After taking his B.Sc. degree he became reader of natural philosophy in Bedford College for Women in 1875, and in 1879 assistant professor in applied mathematics in University College, London. In 1881 he was selected as professor of physics in the University of Liverpool and soon began to make a name for himself as an original investigator.

Lodge's powers of exposition led to invitations to give lectures or courses at other places. He gave a lecture at the Royal Institution on the discharge of a Leyden jar in which he pointed out the importance of resonance or tuning when dealing with electric oscillations. In a lecture course at the Royal Society of Arts he discussed the nature of lightning discharges and surmised that they might consist of high-frequency electric discharges. This study led him to devise experiments on the propagation of electric waves along wires and he came very near to anticipating the work of the German physicist H. H. Hertz on the production of Maxwell's electromagnetic waves in space.

Hertz's work was carried out at Karlsruhe and Bonn between 1885 and 1888. His masterly experimental work on this subject excited world-wide interest. Lodge threw himself with the greatest enthusiasm into the work of repeating and extending that of Hertz. Lodge devised experiments to show the similarity between optical effects such as refraction and reflection of light and those of electromagnetic waves. This prepared the way for his original work on wireless telegraphy. Hertz had employed as a detector of electric waves a simple ring of wire with spark balls inserted in it. But this was not at all sensitive. Lodge adapted for that purpose a tube loosely filled with metallic filings which in that condition was a poor electric conductor. But the impact of electric waves on it caused a coherence to take place between the metallic particles and hence Lodge named it a coherer. If given a slight tap the filings came back into the non-conductive state and accordingly Lodge made a self-acting tapper on the principle of the electric bell which continually restored the filings to a state of poor conduction.

Hertz died in January 1894, and in June of that year Lodge gave a brilliant lecture at the Royal Institution on the work of Hertz. No mention was made of electric wave telegraphy in that lecture; but, using his coherer, experiments were shown illustrating the production, detection, and properties of electric waves. In the autumn of that year Lodge repeated the lecture before the British Association at Oxford and on that occasion he showed that with a deadbeat Kelvin galvanometer long or short deflections of a spot of light could be created by means of a Hertz radiator in a distant room. Thus Morse code signals and intelligence could be transmitted. By the use of a more powerful radiator, Marconi covered miles instead of yards. In a British patent taken out about this time, Lodge pointed out the necessity for syntony or tuning between the transmitter and receiver. This patent later on became of great importance and was acquired by the Marconi Company. In conjunction with Dr. Alexander Muirhead, Lodge worked out later on a complete plant for wireless telegraphy. He must therefore be considered as one of the pioneers of this important application of experimental research.

Lodge was, however, more interested in pure research than in its applications. He had a firm belief in the actuality of a space-filling ether and endeavoured by various experiments to prove a connexion between matter and ether, but without results. He expounded his views in various papers and books, for example, "Modern Views of Electricity", "Electrons", and "The Ether of Space".

In 1900 he was chosen as first principal of the University of Birmingham, where he remained for nearly twenty years, and by the breadth of his interests and personal character he made himself known and beloved by an extensive circle.

Lodge was knighted in 1902 and was the recipient of numerous honours, such as the Rumford Medal of the Royal Society in 1898 and the Albert Medal of the Royal Society of Arts in 1919. He was elected fellow of the Royal Society in 1887, and president of the British Association in 1913.

His personal appearance was impressive. He was 6 ft. 4 in. in height and in middle life had a strong facial resemblance to a former Lord Salisbury. He always commanded serious attention in any meeting at which he spoke. He was happy in his domestic life, and had a large family of six sons and six daughters.

Lodge became prominent as a leader in psychical research. In common with his friend F. W. H. Myers, he had a strong conviction of the survival of some part of the human personality after the death of the bodily organism, and he sought to prove it in various ways. The writer is not, however, qualified to evaluate Lodge's work in this region. His attention to it was not the outcome of mere scientific curiosity but of a firm belief in the value of human life and the eternal consequences of human conduct. Above all he did not consider the universe to be the outcome of an automatic evolution but the creation of a Supreme Intelligence. He had a serious and reverent outlook on human life and his wide and valuable work in numerous fields will ensure for his name an enduring recollection as well as an affectionate remembrance by many minds.

Sir Oliver Lodge died on August 22, at Normanton House, Lake, near Salisbury, where he had lived for many years.

AMBROSE FLEMING.

I FIRST met Sir Oliver Lodge about the year 1877 when he used to come to South Kensington for the May examinations of the Science and Art Department. At that time the Physical Society used to meet on Saturday afternoons, and the meetings were very different in character from what they became when the time of meeting was changed to Friday afternoon. They were less severe, and the friendly and almost chatty atmosphere of a tea party prevailed. Lodge was very much at home on these occasions, and he was always listened to with interest. His clear speaking and characteristic and musical voice and originality of view made his contributions to the discussions valued and attractive.

The subjects ranged over the whole field of the classical physics of that epoch. I remember in particular one source of much discussion—the seat of electromotive force in the voltaic cell. Lodge had a great deal to say on the apparently erratic behaviour of lightning, which did not seem to understand the clear rules of behaviour set out in the textbooks. He devised and showed experiments based upon the idea, so far as my very imperfect memory goes, that the stroke came direct not from a great mass of cloud but from a region suddenly charged by a discharge from the cloud, which seems to approach the step-by-step action of the leader-stroke discovered by Schonland. It so happens that I have seen very little of Lodge during the last thirty years, but I was very glad, when my premises were visited by a peculiarly freakish flash (see NATURE, **131**, 765; 1933), to get him to come over and see what had happened. It may be worth while mentioning that the black Italian poplar tree struck is still doing well, having an edge of growing cambium encroaching over the stripped trunk four inches thick.

I do not know what attitude Lodge assumed towards games and sports in general. I remember, however, taking part in a game in his house in which he excelled. It is quite likely that he invented it. A string or tape is stretched across the hall to serve as a tennis net, and the players at very close quarters beat with their flat hands an ordinary child's india-rubber balloon over the net. This may sound a mild pat-ball style of game, but actually it is most strenuous. By giving well-directed glancing strokes the ball is made to spin and advance very rapidly, but owing to the rotation its motion seems as erratic as that of lightning—it may even loop the loop—and it is a very difficult matter to return it at all. I like to conclude this very short and imperfect personal note with the picture of Sir Oliver towering behind the net, with smiles all over his face, and with his long reach and his firm and well-directed slicing strokes enabling him to harass his opponent.

C. V. BOYS.

WE regret to announce the following deaths:

Prof. C. C. Caleb, formerly professor of physiology in King Edward's Medical College, Lahore, on August 26, aged seventy-nine.

Prof. W. Lash Miller, C.B.E., emeritus professor of physical chemistry in the University of Toronto, on September 1, aged seventy-three.

NEWS AND VIEWS

Sir J. J. Thomson, O.M., F.R.S.

PHYSICISTS and others will have read with much regret the announcement in the daily papers at the end of last week of the death on August 30 of Sir J. J. Thomson, whose name will always be associated with the discovery of the electron, the fundamental unit of electricity, and the basis of modern views on the structure of matter. So long ago as 1913, NATURE published an account of his work, written by Prof. Augusto Righi, in the series of "Scientific Worthies", and the intervening years have but served to emphasize the importance and significance of his work there described. The decision to accord him a national burial at Westminster Abbey was a fitting memorial to one whose name had passed into international usage. At a later date, we hope to print some personal appreciations of Sir J. J. Thomson, though unfortunately we are cut off from many who would otherwise no doubt have paid their tribute to him who will always be known affectionately as "J. J."

H.M. the King has sent the following message to Lady Thomson: "I am grieved to hear of the death of your distinguished husband, whom I remember so well from my Cambridge days. His loss will be deeply felt both in the University and the world of science, where he played so great a part. I send my sincere sympathy to you and to your family."

Les Français de Grande Bretagne

MONSIEUR ANDRÉ LABARTHE, director-general of the Department of Armaments and Scientific Research in General de Gaulle's Legion, addressed a meeting of "Les Français de Grande Bretagne" on August 31, at the Central Hall, Westminster. Courage, decision and tenacity begin to bear fruit, he said. The French Empire is awakening from its stupefaction, and coming back to life. It is rallying to that French flag which General de Gaulle has raised again, to that flame which he has known how to shield from all blasts of misconception, carping and discouragement. This is the meaning of the reentry into the war of French Equatorial Africa, the Cameroons and Lake Chad Territory, a re-entry of which the importance, material and moral, strategic and political, no one can overlook. In France itself, the rulers have sought to save their country from destruction by begging for a shameful armistice, and have opened the way to the most disastrous concessions. On one hand, the Germans are methodically pillaging the richest and most productive parts of the country, on the other the flood of refugees and the scarcity of transport are creating chaos and famine. Workers have left their factories and hungry children wander along the roads. Bit by bit, defeated France is handed over to the tender mercies of the conqueror. She can no longer even remain neutral; she is being dragged into the war on the side of the Germans.

Faced by such a situation, the duty of Frenchmen resident in Great Britain is clear. Some of them have lived in Great Britain for a long time; others have arrived since the disaster. Let the former recall that they have enjoyed here the liberties of a great democratic country, and the prestige of their own native land; that they must now defend these liberties and restore this prestige. Let those who have lately arrived remember that, coming from a country which has betrayed the common cause, they have nevertheless been received here as friends, have been helped and comforted. There is now no time to hesitate or weigh the consequences. Let all become combatants in the cause of the British Commonwealth of Nations, which remains the cause of France. Gathered around General de Gaulle in the Association "Les Français de Grande Bretagne", bound in a common brotherhood with the British, let them ensure, by increasing work and propaganda, the persistence of that spiritual unity which, even more than race or territory, is the essence of France.

Prohibition of High-Frequency Apparatus

THE Home Secretary has made an Order in the interests of national security forbidding any person in the United Kingdom to use or possess high-frequency apparatus having a high-frequency output of more than 10 watts, except under permit from the Postmaster-General. Such permits may be issued only to hospitals, clinics, or other institutions providing medical or surgical treatment, which are provided by a local authority or supported wholly or partly out of any public funds or by a charity or by voluntary subscriptions; to manufacturers who require to use high-frequency apparatus; to makers of and dealers in such apparatus; and to persons in charge of laboratories used for purposes of research or instruction.

It is explained that the danger of interference at a vital moment to the wireless communications of the Services and to the radio control of our own aircraft is so great that it has been found necessary to issue the prohibition. The operator of this type of apparatus is nearly always unaware of the interference it is causing, and it is most difficult for the Service being interfered with to locate the source of interference. The Order came into force on September 2. Permits to use such apparatus may be obtained from the Engineer-in-Chief, Radio Branch, General Post Office, Harrogate, Yorks.

Smoke Abatement

THE National Smoke Abatement Society has issued the fourth war-time issue of its journal *Smokeless Air*. The Editor justifies this effort by the necessity for keeping in view the ideal of a cleaner atmosphere when the time comes for post-War reconstruction so that such an opportunity shall not be lost for want of forethought. Prominence is given to a recent paper by H. H. Thomas and P. J. Askey describing work at the Liverpool Gas Co. on the production of reactive coke by alkali activation. For some years it has been known that a little sodium carbonate alters the mode of burning of carbon, making it blaze more freely. The quantity of alkali necessary can be replaced to a great extent by lime with a corresponding reduction of cost. The authors record results of a large-scale trial in which coal treated with 1·25 per cent lime and 0·5 per cent sodium carbonate was carbonized in normal gas retorts. The coke so produced over a period of seventeen months has been sold to Liverpool consumers for use in the fireplaces in normal use and to the general satisfaction. In ease of combustion the fuel compared favourably with low-temperature coke, with the advantage that it was made in standard gas-making plant at high temperature, without sacrifice of the yield and output of gas—factors of importance in ensuring economical working.

Malaria in Costa Rica

A. A. Guzmán discussed the problem of malaria in Costa Rica at the Eighth American Scientific Congress on May 17. Due to climatic variations because of altitude, malaria is distributed irregularly in Costa Rica, most of it being confined to the low coastal areas and the Nicaraguan frontier, although some high valleys are also infected. Since the greater part of the inhabitants live on the high central plateau, in the cities of Alajuela, Cartago, Heredia and San José, the incidence of malaria is lower than would otherwise be expected. In 1938 and part of 1939 more than 9,000 primary school children in 168 localities were examined for spleen enlargement, the results indicating that six times as much malaria occurred in areas less than 1,000 ft. above sea-level as in higher regions. Blood smears from every child with splenic enlargement, and from one third of the rest, were examined microscopically, 3,981 smears from 9.226 children (43 per cent) being examined. Giemsa stain was used. *P. vivax* and *P. falciparum* were found throughout the malaria region ; *P. malariæ* was most common on the Pacific coast and in the Province of Guanacaste.

The scarcity of funds for malaria control work resulted in a decision to begin by carrying out permanent work in two localities, and proceed on the basis of an annual appropriation to carry forward the work of draining centres of population, before attempting to deal with malaria in rural areas. The work was begun in 1939 in Liberia, capital of the province of Guanacaste, which had the highest splenic index among school children, with the installation of drainage ditches made of pre-cast concrete sections as used by Dr. D. P. Curry in the Panama Canal zone. At the same time the town of Las Cañas, similar in conditions to Liberia, was left unsanitated as a control. The splenic index in Liberia was reduced to one fourth of the original figure ; that in Las Cañas remained unchanged. Drainage work was then begun in Las Cañas in 1940. During 1939, 6,908 concrete inverts, 9,573 side slabs, and 145 sections of concrete pipe were made in the Liberia shop. By December 1939 slightly more than 4 km. of ditch had been laid in the Liberia area, at a total cost, including heavy equipment, of approximately 18,600 dollars, to which the Costa Rican Government contributed about 87 per cent and the Rockefeller Foundation 13 per cent.

Exposure to Fluorine in Industry

W. Machle and E. E. Evans (*J. Indust. Hyg. and Toxicol.*, 22, 213 ; 1940) have reviewed the literature on the effect of industrial exposure to fluorine and record the following personal observations. They found that five years of intermittent exposure to concentrations of fluorine which were harmful to rabbits and monkeys were tolerated by a group of industrial workers without clinical or röntgenological evidence of damage and without injury to the blood as shown by hæmatological examination. Comparative examinations showed them that the exposure of the workers resulted in the absorption of more than three times the normal amount of fluorine. Experiments on animals indicated that this continuous absorption would result in the deposit of abnormally large amounts of fluorine in the teeth and bones, but clinical evidence of this kind has not yet appeared.

Pre-Columbian Burial in Panama

An archæological expedition to Panama of the University Museum of the University of Pennsylvania, under the leadership of Dr. J. Alden Mason, has discovered the tomb of a chief or official in which the intrinsic value of the personal ornaments recalls the stories of the early Conquistadores of the wealth of the Central American caciques in precious metal, to which the finds of Dr. Alfonso Caso on Monte Alban in Mexico have also borne eloquent testimony. The find was described by Dr. Mason in a first report of the expedition before the Eighth American Scientific Congress in Washington, D.C. He described the burial, it is stated in a brief report circulated by Science Service, as a pit 11 ft. deep. In it had been laid the body of the chief, "resplendent . . . in shining gold". His ornaments included gold cuffs and anklets, great shining disks of this metal ornamenting his clothing, golden ear-clips, bells, and beads. From layers of broken pottery, Dr. Mason concludes that the mourners must have danced on or trampled pottery into the grave in some burial rite. This discovery was made in a vegetation-covered graveyard on a plantation in Coclé Province, one hundred miles west of Panama City. The origin of the people responsible for the burial has not yet been determined ; but the culture differs from that of both Maya and Aztec and points to South rather than North American affinities. The find is dated as belonging to the period 1300–1500 of our era.

Australia's Electrical Requirements

An Australian correspondent writing in the *Electrical Times* of August 22 says that the rapid expansion of secondary industries in Australia has been particularly noticeable in the production of electrical machinery, equipment and appliances to meet the needs of both heavy and light industries, in addition to the general electrical requirements of the Australian public. This is of interest to manufacturers who supply electrical products to the Commonwealth. The number of factories has increased during the last ten years from 231 to 360. It is of interest from the point of view of increased competition with overseas suppliers, apart from protective tariff duties, that the ratio per cent of salaries and wages to values of production has gone down from 68 per cent in 1930–31 to 55·6 per cent in 1938–39. Similarly, the value of output per person engaged increased during the same time from £A.529 to £A.652. The range of electrical equipment now produced in Australia, although far from being sufficient to meet domestic requirements, covers a fairly wide field; and there is quite an extensive range of radio-equipment for ocean-going vessels, aircraft beacons of the new ultra-high-frequency type and short-wave receiving sets, all of which are being manufactured in the Commonwealth.

Despite Australia's substantial production of electrical machinery and equipment, the annual value of which is now more than £A.7,000,000, the value of total imports from overseas countries amounted in 1938–39 to approximately £A.5,700,000. Of the products imported, a considerable proportion is made up of items which as yet cannot be economically produced in the Commonwealth and are required to meet the steady expansion of secondary industries and public utilities. With the majority of European suppliers, with the exception of the United Kingdom, now unable to effect shipments, and with the German occupation of Holland, Denmark, Belgium and France, it will be necessary for consumers to seek other sources of supply, particularly for urgent electrical requirements. Although certain electrical commodities may at present be prohibited entry to Australia from non-sterling countries, this situation is subject to alteration from time to time. In the event of such products being unavailable from the United Kingdom or within Australia, licences to import from British North America would no doubt be obtainable.

Lighting Installation of the Savoy Chapel, London

THE King's Chapel of the Savoy, Strand, London, which is all that remains of the Palace and Hospital of the Savoy, is the personal property of the King by right of his Duchy of Lancaster, of which the Savoy became the centre in 1351. His Majesty, at the time of the Coronation, placed the Chapel at the disposal of the Royal Victorian Order, to be regarded as the Chapel of the Order. Recent additions made have launched it on a new era of importance, and it can now be used for the first time for ceremonial purposes. The Chapel stands low and was approached by a narrow flight of steps. Its new approach consists of a stone parapet with broad sideways flights of steps which make robed processions possible. A robing room and a new cloister are other additions to the ancient building. In the Chapel itself space-saving ideas have been carried out to make more room. The Royal stalls have been designed as part of the new wall panelling where the old organ stood. A miniature electric organ, similar to the one in Canterbury Cathedral, has been installed. The beautiful ceiling of eighty-eight wooden panels has been cleaned and retouched to a parchment shade, and can now be seen to full advantage owing to the concealed lighting from the sills of the windows, which lights the whole of the interior of the Chapel, and in peacetime allows the stained glass to be seen from outside by transmitted light. The whole of the design of the lighting installation was carried out by G.V.D. Illuminators, Ltd.

Hydraulic Structures Research in Canada

THE National Research Council of Canada has recently provided in Ottawa facilities for hydraulic structures research. The new laboratory, which is a part of the Division of Mechanical Engineering, has been planned to supplement the limited facilities which are at present available in Canada for work of this kind. The design of structures such as canal locks, dams, spillways, gates and power plant details can be investigated and work may be undertaken on river hydraulic problems of limited extent. Many pipe-flow problems are also within the scope of the laboratory. A feature of the laboratory is the large flow of water available which will be adequate for the largest models that can be accommodated. A complete description, with drawings, of the new hydraulic laboratory was published recently in the *Engineering Journal*. Reprints (N.R.C. No. 937) are available from the National Research Council, Ottawa.

Mr. F. C. Bawden

MR. F. C. BAWDEN has been appointed head of the Department of Plant Pathology at Rothamsted Experimental Station, in succession to Dr. J. Henderson Smith, who is shortly retiring, having held the post since 1932. Mr. Bawden was a scholar of Emmanuel College, Cambridge, and after taking a first class in the Natural Sciences Tripos and the diploma in Plant Pathology, he spent five years as research assistant at the Potato Virus Research Station, Cambridge, under Dr. R. N. Salaman. In 1936 he transferred to Rothamsted to take charge of the investigations on virus diseases of plants, in which he has been conspicuously successful. He was invited last summer to lecture in the United States on his investigations, but returned to Great Britain shortly after the outbreak of the War.

Agricultural Research Council: New Members

THE Committee of Privy Council for the Organisation and Development of Agricultural Research has appointed, to fill vacancies caused by normal retirement, Sir Robert Blyth Greig, and, after consultation with the president of the Royal Society, Prof. W. W. C. Topley, Prof. E. J. Salisbury and Prof. T. J. Mackie, as members of the Agricultural Research Council. Sir William Cecil Dampier and Mr. John Smith have been reappointed for a further term.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Diffuse Reflection of X-Rays by Single Crystals

IN a recent letter, A. Taylor and D. Laidler[1] describe anomalous reflections to be found on photographs of graphite taken with cobalt $K\alpha$ radiation, and suggest that these may be similar to the diffuse spots to be found on well-exposed Laue photographs. This is not possible; such diffuse reflections may indeed occur on a powder photograph, but only as a *background* and *broadening* of the Bragg reflections from the normal planes.

Since the experimental conditions governing the appearance of the diffuse spots found on Laue photographs do not seem to be clearly understood, it may be helpful to describe some of the results obtained from an investigation now in progress in this laboratory, during the course of which some thousands of such spots have been observed.

The principal crystals examined were potassium chloride, benzil, α-resorcinol, urea oxalate, urea nitrate, sorbic acid, hexamethylbenzene; a few photographs of diamond and of sodium nitrate have also been taken. The radiations used were copper, molybdenum and silver, both unfiltered and suitably filtered. Exposures varied from 70 min. using an ordinary gas tube, to 5 min. or less using the 5 kw. tube. With a monochromator, exposures of 1–3 hours were necessary. Various plate distances were used and for the low-temperature work the technique employed was similar to that previously described by two of us[2].

The main lines of investigation have been: (1) to take Laue photographs with a principal axis vertical, at 5° or 10° intervals over the whole rotational range, and/or at 1° intervals over a limited range; various axes have been investigated; (2) to take separate oscillation photographs having the "Laue" positions as the centres of the oscillations, various ranges being covered; (3) to superimpose oscillation and Laue photographs on the same film; (4) to take selected Laue photographs with strictly monochromatized radiation (copper $K\alpha$ only); (5) to take successive Laue photographs under otherwise similar conditions at room temperature, liquid air temperature and room temperature again.

A few experiments have also been made at elevated temperatures, and Laue photographs have been taken with the crystal surface completely covered with a drop of liquid in which it is soluble.

Briefly, the conclusions arrived at are as follows:

(*a*) The diffuse spots are due to characteristic radiation present in the incident beam. Continuous radiation gives radial streaks.

(*b*) When a principal crystal axis is vertical, the positions of most of the diffuse spots are nearly coincident with those of Bragg spots on the corresponding oscillation photograph covering a range of some 10°–15° on each side of the stationary position in which the Laue photograph was taken. Very well-exposed oscillation photographs show a diffuse background to each Bragg spot. This agrees with the observation that the diffuse spot pattern changes much more slowly than the Laue pattern on successive photographs at small angular intervals. Not all diffuse spots correspond to an oscillation about a vertical axis only, but *all* are accounted for by limited oscillations about other principal crystallographic directions also. Some photographs showed as many as 42 diffuse spots; all these could be assigned indices as being due to the reflection of characteristic radiation by planes of nearly normal spacing (that is, within 5 per cent of the usual spacing), displaced by less than 10° (or in the exceptional case of a strongly reflecting cleavage plane, less than 17°) from the normal lattice position. It follows that in a powder, where all crystal orientations are present, the diffuse monochromatic reflection would occur only as a broadening of each line so as to include spacings of up to ± 5 per cent of the normal spacing, the limiting intensity being very small.

(*c*) The intensities of the diffuse spots are dependent upon two factors: first, on the normal intensity of the corresponding characteristic reflection measured in its proper position and secondly, on the angular separation of the diffuse spot from the Laue spot due to the same set of planes.

(*d*) At liquid air temperatures, the diffuse spot pattern almost completely disappears, the Laue spot pattern becoming extremely clear and the background clean. (This has only been satisfactorily proved for potassium chloride, sodium nitrate, benzil and α-resorcinol.) These effects are *completely reversible*. Experiments at elevated temperatures confirm Preston's observation of a relative enhancement of the diffuse spot pattern.

(*e*) The diffuse spot pattern does not appear to be affected by covering the surface of the crystal with a drop of liquid in which it is soluble, provided that sufficient of the crystal remains to give a Laue photograph at all.

(*f*) A striking feature of certain of these photographs is the presence of diffuse streaks clearly marking out the layer lines. The result is that some of the spots in benzil photographs appear to be six-pointed stars, others in sylvine and sorbic acid appear as crosses. Laue photographs of benzil with *monochromatized* radiation show a beautiful and intricate pattern of spots and continuous streaks, none of which is radial. Even when the layer lines are not completely defined, isolated spots are drawn out into hyperbolic streaks, and sometimes non-radial streaks appear without any well-defined spot.

(*g*) The size of the diffuse spots shows that they are not given by small crystal units. Except in the case of diffuse spots corresponding to a cleavage or 'layer' plane, the half-maximum intensity width is not in general much larger than that of the corresponding Bragg spot. The shape of the diffuse spot is, in general, that of the corresponding Bragg spot and often differs markedly from that of the corresponding Laue spot.

Some of these conclusions confirm those previously reported by other workers; others are new. They will be published in detail elsewhere.

It is not our object in this communication to relate the experimental results to any of the existing divergent theories. The final test of any theory, however, must be based on detailed qualitative and quantitative experimental data.

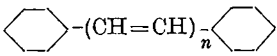
K. LONSDALE.
I. E. KNAGGS.
H. SMITH.
Davy Faraday Laboratory,
Albemarle Street,
London, W.1.

---

[1] NATURE, 146, 130 (1940).

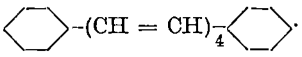
[2] Lonsdale, K., and Smith, H., *Phil. Mag.* (7), 28, 614 (1939).

Dimorphism of Diphenyl Octatetraene Crystals

THE crystal structures of the diphenyl polyenes, having the general formula , have been studied by Hengstenberg and Kuhn[1] by X-ray methods. They find that while the lower members of the series, with $n = 1$ to 4, crystallize in the monoclinic system, the higher members studied by them, for which $n = 5$ to 7, crystallize in the orthorhombic system.

Recently, in the course of some electrical and optical measurements on this important series of compounds possessing conjugate double bonds, we had occasion to study the crystal structure of one of them, namely, diphenyl octatetraene, corresponding to $n = 4$. On allowing this substance to crystallize from its solution in acetic ether, we found that in addition to some flaky crystals which were monoclinic and had the axial dimensions described by Hengstenberg and Kuhn, there also appeared in the same crop stout well-developed crystals which were orthorhombic. The chemical identity of the two types of crystals is verified by the observation that both types appear in the crops obtained by the evaporation of the solutions in acetic ether of either of them separately.

n	a	b	c
	in A.		
5	10·25	7·66	21·2
6	10·20	7·60	23·58
7	10·2	7·57	25·95

The orthorhombic crystal belongs to the bipyramidal class, and its unit cell has the dimensions $a = 9{\cdot}95$, $b = 7{\cdot}55$, $c = 19{\cdot}75$ A., and contains 4 molecules of  These dimensions fit well with the dimensions of the unit cells of the higher members of the series—all of which contain 4 molecules—obtained by Hengstenberg and Kuhn, and reproduced in the accompanying table.

K. S. KRISHNAN.
S. L. CHORGHADE.
T. S. ANANTHAPADMANABHAN.
Indian Association for the
Cultivation of Science,
Calcutta.

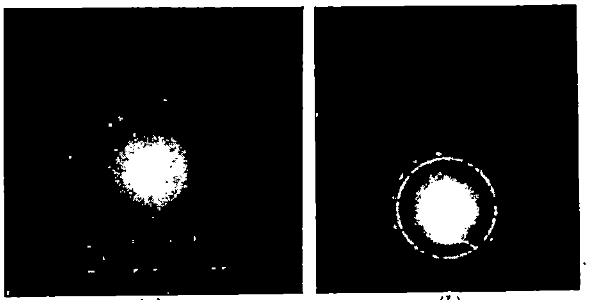
June 15.

---

[1] *Z. Kristallog.*, A, 75, 301 (1930).

Study of Amorphous Films by Electron Diffraction

SINCE it is necessary to maintain the electron camera used in electron diffraction studies in a state of high vacuum, the investigation of solutions is in general very difficult. However, the desiccation of hygroscopic substances like zinc chloride does not take place very rapidly even in high vacua of the order of $10^{-6} \sim 10^{-8}$ mm. mercury; as a matter of fact, the thin films of such substances give diffraction haloes as well as diffraction rings (see photographs). The purpose of this study is the determination of the inner structure of amorphous films of very concentrated solutions through the diffraction patterns obtained.



(*a*) (*b*)

ELECTRON DIFFRACTION PATTERNS FROM $ZnCl_2$-H_2O FILMS. IN (*b*) THE RINGS DUE TO $ZnCl_2$ CRYSTALS ARE BEGINNING TO APPEAR.

A platinum wire-gauze of about 0·5 mm.^{2} dimensions was previously washed with dichromic acid. After immersing the gauze in a saturated aqueous solution of zinc chloride for several hours, a thin film was successfully obtained adhering to every part of the gauze. The films thus obtained were so hygroscopic and had so remarkable a surface effect that they were not easily broken and served satisfactorily for the purpose in the electron diffraction study. Both diffraction patterns shown in the accompanying photographs were obtained by transmission of an electron beam through the $ZnCl_2$-H_2O film; whereas in *a* haloes are prominent, in *b* rings are conspicuous. By referring to X-ray data it was clearly verified that these rings were from $ZnCl_2$ crystals (hexagonal, $CdCl_2$ type); therefore, it is clear that the solution under examination is saturated, and its "base-body" is $ZnCl_2$.

If the lattice spacings determined by measuring the radii of haloes remain constant even when the wave-length of the electron beam is altered, it may safely be assumed that the halo pattern obtained is due to the diffraction grating characteristic of the thin film consisting of a saturated solution. The results of the experiment were positive in the several wave-lengths used, namely, 0·0756, 0·0807 and 0·0858 A.; the lattice spacings were respectively 4·5, 2·4 and 1·45 A. The haloes are not only sufficiently diffuse to be distinguishable from the sharp rings given by $ZnCl_2$ crystals, but also they appear in the pattern in positions where $ZnCl_2$ crystals cannot produce diffraction rings.

I am now endeavouring to build up a model of the grating characteristic of this film. This work has been conducted under the direction of Dr. Ichirô Iitaka.

SHIGETO YAMAGUCHI.
Institute of Physical
and Chemical Research,
Tokyo.

Adsorption of Malachite Green by Clays and Allied Minerals

THE malachite green stain test has long been used as a means of identifying kaolinite, dickite, and nacrite[1]. The quantitative aspect has not been dealt with adequately, and the method has never been applied with discrimination. Working on mineral separates obtained during the physical analyses of clays and soils, I have used staining quite extensively. Previously identified specimens of kaolinite, beidellite, etc., were used as controls, and the following represents the general colour reactions, after staining, drying, and mounting such separates.

Mineral	Colour of Stained Mineral	Pleochroism
Kaolinite	Deep-blue green	Marked
Anauxite	Light to deep blue-green	Not very marked, but variable
Montmorillonite	Marine blue	None
Pyrophyllite	Blue-green	None
Talc	Blue-green	None
Beidellite	Marine blue	None
Margarite	Not markedly stained	None

It was obvious after performing a few stain tests that these minerals adsorb different amounts of the dye, and take it with varying degrees of 'fastness'. For example, kaolinite is stained a deep blue-green colour in such a manner that no amount of washing with water, acid or alkali will remove the malachite green. The colour can be changed from blue-green in alkaline solution to a light red in acid conditions. It must also be noted that in the case of kaolinite and anauxite the birefringence is increased by staining from 1st order greys to 2nd order reds and purples.

Shand[2], in a paper on the staining of etched sections of feldspathoidal rocks, remarks that long contact with the staining solution is unnecessary. My work on clays has confirmed this, and the following figures indicate that ten minutes contact with a 0·05 per cent aqueous malachite green solution is sufficient to remove more than 90 per cent of the dye from it.[3]

KAOLINITE-RICH WHITE KAOLIN

Time of contact in min.	Adsorption of malachite green
1	85
5	89
10	92
60	93
120	93

In this case the dye is never completely removed, whereas bentonitic clays and fuller's earths adsorb the malachite green from much stronger solutions. So far, no accurate diagnostic values of the amount of adsorption for the various minerals have been found. In fact, anauxite, for example, has a range of values depending probably upon its composition. With the exception of some of the kaolinites, few of the minerals used in this investigation were uncontaminated by other minerals. Fortunately, in every case the main impurity was quartz, which does not take the dye.

V. L. BOSAZZA.

University of the Witwatersrand,
Johannesburg.

[1] Ross, C. S., and Kerr, P. F., U.S. Geol. Surv. Prof. Paper (1931).

[2] Shand, S. J., *Amer. Min.*, **24**, 568-573 (1939).

[3] Holmes, A., "Petrographic Methods and Calculations", p. 275 (1930).

Correlation between Egg-Carrying Setæ and Cement Glands in Decapod Crustacea

IN the Decapod Crustacea the female possesses characteristically long non-plumose setæ on many of the abdominal, and in some cases certain of the posterior thoracic, appendages. It is to these hairs that the eggs are attached when the animal is in berry. It has been further shown by one of us[1] that in *Homarus vulgaris* ducts from the cement glands, which occur exclusively in the pleopods of the female, pass into the interior of these specialized setæ, "circumstantial evidence indicating that the secretion is discharged through the sides of these". In other words a direct correlation was postulated between the setæ and the glands, the former providing the surface of attachment of the eggs and the latter the necessary binding cement.

Confirmation of this view has now been provided as a result of work on *Crangon vulgaris*. As already briefly noted by Havinga[2] and in more detail by Meyer[3], mature females alternate between an egg-carrying condition when these setæ are present, and what may be described as a 'neuter' condition when they are absent. Similar cyclical appearance of secondary female characters had already been described by Sollaud[4] in other Caridae, in species of Leander and Palæmonetes. This has recently been confirmed by Callan[5] in *Leander xiphias* and *L. squilla*. In *C. vulgaris* the female does not become mature until she attains a length of about 45 mm. Previous to this the ovary is small, the egg-carrying setæ are represented by no more than vestiges while cement glands are absent. But prior to the moult when sexual maturity is attained, the ovary develops rapidly, and after the moult the egg-carrying setæ are fully developed. With them appear cement glands, one or more being associated with each spine into the cavity of which their ducts penetrate. The animal is then capable of spawning, copulation taking place immediately after this moult if males are present.

After the liberation of eggs the female moults into the 'neuter' condition ; spines are then reduced, and cement glands absent. The ovary then increases in size, and in due course the animal moults into the egg-carrying condition with both spines and cement glands. This alteration of 'neuter' and egg-carrying conditions apparently continues throughout the remainder of the life of each female. A full account of this process will be published in due course by A. J. Lloyd.

This investigation reveals, therefore, that the egg-carrying setæ and the cement glands are in such intimate functional association that they may be regarded as a single secondary sexual character. The correlation between the condition of the ovary and the appearance of these structures provides further evidence in support of the previously expressed view[1] that they are controlled by a hormone produced by the ovary. Moreover, Callan[5] has recently demonstrated that the specialized setæ—and therefore also the glands—are not formed when Leander females are castrated with X-rays or when they are parasitized by Bopyrus.

Department of Zoology,
The University,
Bristol. August 14.

A. J. LLOYD.
C. M. YONGE.

[1] Yonge, *Proc. Zool. Soc. Lond.*, A, **107**, 499 (1938).

[2] Havinga, *J. Con. Inter. Expl. Mer.*, **5**, 57 (1930).

[3] Meyer, *Zoo. Anz.*, **106**, 145 (1934).

[4] Sollaud, *Bull. Biol. France Belg.*, Supple., **5**, 1 (1922).

[5] Callan, *J. Exp. Biol.*, **17**, 168 (1940).

Somatic Mutations of the Straw Locus in Drosophila

A preliminary study of X-ray induced somatic mutations of straw locus in *Drosophila melanogaster* has yielded several points of interest, and as it is unlikely that this investigation can be extended in the near future it seems desirable to record the results even in their present incomplete form.

Pupæ of flies homozygous for straw-3 were irradiated (by Dr. D. E. Lea) with 25,000 r. units. The somatic mutations were sought in the wings. As is well known, each cell of the wing epithelia in normal flies bears a single hair. In straw-3 these hairs are very small, thin and straggly, with an appearance of being incompletely chitinized. Somatic mutations of one of the straw genes to wild-type cause the formation of hairs of approximately normal length. In flies emerging two days after the treatment, 7 isolated mutated hairs were found in 30 wings. Taking the total number of hairs per wing as about 17,000, this gives a mutation rate of 0·5 per r. unit per 10^9 genes; this is some ten times less than the rates recorded by Timofeeff-Ressovsky for a series of genes most of which are known to be somewhat more mutable than the average.

The fact that the normal hairs occurred in single cells shows that the mutations took place in the resting stage following the last mitosis which occurs during wing development. It also demonstrates that the action of the $+^{stw\text{-}3}$ gene can be exerted as late in development as two days before emergence. It was noted, however, that the hairs in mutated cells were somewhat smaller than normal hairs. This might be explained either by an inadequate length of time during which the mutated could act, or by a certain lack of autonomy of the gene; the action of the $+^{stw\text{-}3}$ gene may be to cause the appearance of some substance lacking in stw-3 cells and some of this substance may leak away from the mutated cells into the surrounding tissue. It would be easy to distinguish between these two possibilities in flies in which the mutation had occurred earlier, but in the present experiment the younger pupæ were killed, and no mutations affecting more than a single cell were obtained.

C. H. Waddington.

Strangeways Research Laboratory
and Department of Zoology,
Cambridge.
August 20.

Sclerotiorine, a Chlorinated Metabolic Product of *Penicillium Sclerotiorum*, Van Beyma

A strain of *Aspergillus Terreus* (Raistrick and Smith, 1936) yields two metabolic products containing chlorine: geodin ($C_{17}H_{12}O_7Cl_2$) and erdin ($C_{16}H_{10}O_6Cl_2$). These compounds, crystallizing in fine yellow needles, and melting with decomposition, are the first recorded instances of chlorinated metabolic products of the lower fungi. More recently, the isolation of griseofulvin ($C_{17}H_{17}O_6Cl$) and caldariomycin ($C_5H_8O_2Cl$) (Raistrick *et al.*, 1939; 1940)—chlorinated products of *Penicillium Griseofulvin* and *Caldariomyces Fumago*, respectively—has been described.

The subject of the present communication, to which we propose to give the name sclerotiorine ($C_{20}H_{20}O_5Cl$), closely resembles the above in crystalline structure, but melts without decomposition or the formation of a sublimate.

The strain of *Penicillium Sclerotiorum* used was obtained from the Centraalbureau voor Schimmel cultures, and shows, under certain well-defined conditions of temperature, mycelial pigmentation, ranging from yellow, through orange, to red, which colour is particularly apparent in the actual sclerotia.

Sclerotiorine, which is very slightly soluble in cold dilute Na_2CO_3 and $NaHCO_3$ solutions, is obtained in 2 per cent yield by petroleum ether extraction of the dried mycelium, grown on standard acid Czapek Dox medium at 25° C. in the dark. The compound crystallizes from alcohol in very fine hair-like yellow needles, melting sharply at 206–207° C., and yielding the following analytical results:

C, 64·09%; H, 5·43%; O, 21·00%; Cl, 9·47%; Methoxyl, nil mol. wt., 364.

$C_{20}H_{20}O_5Cl$ requires:

C, 63·92%; H, 5·33%; O, 21·30%; Cl, 9·45%; mol. wt., 376.

Sclerotiorine sublimes to microscopic needles in a high vacuum and gives various colour reactions with aqueous and alcoholic alkalis. With sodium hydroxide and ammonia it behaves as an indicator, red in alkali, yellow in acid, with an interesting clouding of the solution around the turning point.

The properties of the pigment are being further investigated.

T. MacCurtin.
J. Reilly.

Department of Chemistry,
University College,
Cork.
August 8.

Nature of the Feulgen Reaction with Nucleic Acid

Semmens[1] has recently suggested that the Feulgen reaction with chromatin may be due to the purine components of the nucleic acids. The argument rests on his observations that piperidine and pyridine restored to the Feulgen solution its "original" colour, and that certain purines gave "positive" colour reactions.

We have made tests to show that the effect of piperidine and pyridine is not chemically equivalent to the Feulgen (or Schiff) reaction, but is simply due to their basicity the effect of which was pointed out by Feulgen in 1924. We have likewise tested three of the purines used by Semmens, and in no case did any colour develop. We conclude that the Feulgen reaction is specific for the potential aldehyde groups of chromatin. Details of our experiments will be published elsewhere.

H. N. Barber.
J. R. Price.

John Innes Horticultural
Institution, Merton,
London, S.W.19.
August 13.

---

[1] Semmens, C. S., Nature, **146**, 130 (1940).

RESEARCH ITEMS

Amerindian Crania

THE fourth catalogue of crania of North America in the United States National Museum collections by Aleš Hrdlička (*Proc. U.S. National Museum*, 87; 1940) covers crania of Indians of the Gulf States. It includes 1,259 adult specimens, of whom 621 were identified as male and 638 as female, from Georgia, Florida, Tennessee, Texas, Louisiana and other adjoining States. Of these, 237 were deformed so that the measurements of the vault were affected, while the numbers of the specimens from each locality are uneven and sometimes inadequate. Their showing is of interest. The largest part of the peninsula is occupied by moderate to pronounced brachycephals. A narrower strain, characterizing the Seminole, originally formed a part of the Creek and Muskogean complex whose territories ranged from north-west Florida westward and northward. The Seminole type, both in the cranial index and in other respects, connects apparently with that of the south-eastern Algonkins. The prevalent broader headed and high-vaulted Floridian type connects in turn with that of Georgia and reaches, irregularly, so far westward at least as Mississippi. It deserves to be known henceforth as the Gulf type of the American Indian. Texas, in both its broad and its narrow cranial types, stands apart from the rest of the Gulf States—its skulls are but of moderate height. The size of the head in the Gulf States, with the exception of Texas, compares well with that of tribes of similar stature elsewhere on the North American continent. As regards height of skull the Gulf States stand out as a unit. With some of the Pueblos the measurement of this character is the highest in crania of similar breadth and cranial index on the North American continent, nor is there such a broad high-headed large human group elsewhere. This may be a regional development.

Disappearance of Serbian Gypsies

VARIOUS causes are stated by Dr. Alexander Petrovič (*J. Gypsy Lore Soc.*, Ser. 3, 19, 3; 1940) to be responsible for the inevitable disappearance of Serbian gypsies. The nomad gypsy is free, and neither knows nor cares for birth-place, nor where he shall be buried. The world exists to provide him with food. But when a gypsy becomes sedentary there is a fundamental change in his point of view. He never steals in his own village. He knows where he was born and approximately his burial place. His interests are directed towards the village. Although gypsies still have numerous children, they are fast disappearing because they are gradually blending with the gentiles. First, on settling, a trade is sought, usually that of blacksmith, musician or farmer; but the assimilation is most rapid when they begin to do the same work as the villagers, such as agriculture or work in the factories. Then they forget Romani. Most gypsies are of the opinion that a man who does not speak Romani is not a gypsy. A final step is the assimilation of blood, brought about by the marriage of gypsy and gentile. In one village of eighty gypsy families, five, including the richest man, are married to Serbian girls of the peasant class.

Bark Canoe, Dugouts, and Plank-built Boats

JAMES HORNELL, while still convinced of the tenability of his conclusion that both types of the plank-built boat now in use in Europe, the clinker and carvel build, are derivative from the dugout, on further consideration regards the dugout as an intermediate stage only in the evolution of the plank-built boat from the bark canoe (*Man*, August 1940). That the bark canoe represents the earliest form of construction for purposes of navigation is inferred from the circumstances, tools and materials available in the primitive life of a nomadic hunter, and also from the constructional methods of the Australian. Examples of primitive methods of construction of bark canoes are cited from many parts of the world; but among the Australian aborigines all stages of construction leading up to the dugout may be observed. Of these the earliest or most primitive is the trough-shaped bark canoe in which the open ends may be closed with clay, or each end may be bunched together and tied in position with bast fibre or creeper stems. On these follow sharp-ended bark canoes either without internal stiffening, or stiffened by crossed ribs and gunwale poles, upon which follows the development of 'frames' of oblique rib-sticks and then curved transverse frames of pliant rods. Typically sharp-ended dugout canoes show these transverse frames in ridges across the bottom and up the sides, which are left when hewing out the hull. In a further development these ridges disappear. Of plank-built canoes a primitive form is that of three planks without frames sewn together edge to edge, the prototype of the carvel build, or alternatively overlapped, the prototype of the clinker build. In the latter, inverted frames are tied to cleats on the inner side of the planks; in the former, frames are sewn directly to the hull.

Fungus Parasites of Nematodes

CHARLES DRECHSLER, U.S. Bureau of Plant Industry, describes three species of such fungi found in old agar cultures started from diseased rootlets or other decaying vegetable material (*J. Washington Acad. Sci.*, 30, No. 6, June 15, 1940). The agar consistency being firm in these cultures, Drechsler points out that the cultures provided conditions approximating to terrestrial rather than aquatic conditions and the fungi described might therefore attack free-living nematodes under natural conditions in the soil. *Haptoglossa heterospora* (gen. et. sp. nov.) was frequently observed destroying enormous numbers of nematodes; it is characterized by the discharge of non-motile infective structures from non-motile sporangiospores and belongs to one of the zoospore-producing groups of the Phycomycetes. *Meristacrum asterospermum* (gen. et. sp. nov.) is a conidial fungus related to the Entomophthoraceæ and occurred in leaf mould from Wisconsin; it was observed destroying nematodes in agar plate cultures from this leaf mould. It is distinguished by its production of plural conidia, mainly laterally, on a multiseptate conidiophore. The last fungus described possibly did not attack healthy eelworms but only hosts already disabled by a protozoan endoparasite. It is a species of Cephalosporium and is not assigned a name as it is thought that the cephalosporium stage described may only constitute an accessory reproductive phase in the development of the fungus concerned.

Magnesium Deficiency in Fruit Trees

T. Wallace (*J. Pom. & Hort. Sci.*, **18**, 145 ; 1940) reports investigations on the magnesium status of leaves from various fruit plants growing in orchards on different soils. Symptoms of magnesium deficiency in apples, black currants, gooseberries, and plums were accompanied by low magnesia in the leaves. The importance of the base status is stressed. Data for healthy apple leaves show CaO between 1·5 and 2·4, MgO 0·42–0·49 and $\mathrm{K_2O}$ 1·1–1·9 as percentages of the dry weight. Minimum values for MgO and $\mathrm{K_2O}$ consistent with health are given as 0·4 and 1·0 per cent respectively. Symptoms of magnesium deficiency did not appear in conditions of potash deficiency. Leaves showing no symptoms at a given potash level showed definite symptoms when the potash content was raised, though no significant change in magnesium content occurred. Magnesium requirements were increased when liberal dressings of potash were given. Magnesium deficiency may occur in conditions of high or low lime. In the former case, dressings of kieserite or Epsom salts are advised, and in the latter magnesian limestone. In the same journal (p. 119), E. B. Kidston, *et al.*, describe symptoms of magnesium deficiency in apple leaves in the Nelson district of New Zealand. Appearance of the symptoms, brown blotching between the veins, and premature defoliation, were prevented by injections of magnesium sulphate. The deficiency symptoms were most severe where liberal use of potassic fertilizers had been made. High potash in the leaves was correlated with low magnesia. On leached acid soils, magnesium deficiency is presumed to be due to an unfavourable ratio of available potash to available magnesium.

Reproduction in Rubus

M. B. Crane (*J. Genet.*, **40**, 109–118 ; 1940) and P. T. Thomas (*J. Genet.*, **40**, 119–128 ; 1940) show that *Rubus nitidioides, R. vitifolius, R. thysiger, R. calvatus* and others may produce offspring by asexual means. Sometimes these asexual progeny showed segregation of characters. Some species may produce both sexual and asexual progeny. Thomas finds that the embryo-sacs degenerate in *R. nitidioides* and that apospory is probably general in this species. *R. vitifolius*, however, shows a more normal development although there are sometimes abnormalities in the differentiation of the embryo-sac nuclei. *R. nitidioides* regularly reproduces by apospory, while *R. vitifolius* pollinated with diploid *R. idæus* reproduces sexually, and pollinated with tetraploid *R. idæus* it may produce progeny by apomixis. Further, segregation may occur in this apomictic series. Thomas directs attention to the fact that the transition from completely sexual to completely apomictic reproduction is correlated with the transition from allopolyploidy to autopolyploidy and the related sterility phenomena.

New Plant Diseases

W. C. Moore, of the Ministry of Agriculture's Plant Pathological Laboratory, Harpenden, keeps a watch over some of the minor maladies of plants as well as upon the major diseases. Three new examples of lesser-known pathology are described in a recent short paper (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 59–63, June 1940). *Lobelia syphilitica* var. *nana* is attacked by a fungus of the genus Septoria, probably *S. Lobeliæ* Peck. This causes irregular pallid blotches upon the leaves, which are ultimately killed ; the disease has appeared in America and Germany, and has only appeared yet as an isolated instance in Great Britain. Another species of Septoria also attacks *Campanula Raineri*, which unfortunate host is further parasitized simultaneously by *Ascochyta bohemica* Kab. and Bub. The third disease is a root and bulb rot of tulips caused by *Pythium ultimum* Trow., the pathogenicity of which has been proved by isolation and re-inoculation. This is, perhaps, scarcely one of the minor plant diseases, for it is probably more widespread than is commonly known. The present account discusses some of the environmental factors which affect the severity of attack. Plant pathologists should find this paper, and the earlier ones of the series in the same journal very useful in the identification of infrequent maladies.

Extreme Specialization of a Rust Fungus

The very close specialization exhibited by many rust fungi is well known to mycologists, but *Uromyces Scirpi* appears to provide an extreme form of host preference. It is heterœcious, having uredo- and teleuto-spores on *Scirpus maritimus*, with spermagonia and æcidia on *Glaux maritima* or on *Œnanthe crocata* and other umbellifers. Grove and Chesters described the occurrence of the æcidial stage on *G. maritima* at Gorleston in Norfolk, though not on susceptible umbellifers in the neighbourhood, and also the appearance of æcidia on *Œnanthe crocata*, but not on surrounding *G. maritima* at Saltash in Cornwall. There seems to be a specialized host relation in the æcidial stage, and this conclusion is now reinforced in a detailed paper by Margaret Fort (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 98–108, June 1940). Infection experiments and cytological investigations were carried out with material from Fife where *S. maritimus* and *Œnanthe crocata* were natural hosts, and no æcidia were seen on the neighbouring Glaux. Œnanthe was repeatedly infected and re-inoculations to *S. maritimus* proved the life-cycle, but no inoculation of *G. maritima* was successful. Mycelium on *S. maritimus* was binucleate ; that on *Œnanthe crocata* uninucleate until after the production of spermatia, when binucleate cells appeared regularly in the base of the developing æcidium.

Earthquake Work at Toledo, Spain

During the first quarter of 1940, fifty earthquakes were registered on the Weichert seismographs at the Geophysical Observatory at Toledo (director, Enrique Barrios). Six of these were sufficiently well registered to have their epicentres determined. The first on January 6 was near New Caledonia (22° S., 170° E.). The second on January 17 was near the Mariana Islands (17° N., 148° E.). The third on February 7 was near the Aleutian Islands (52° N., 174·5° E.). The fourth on February 12 was near the coast of Chile (26° S., 71° W.). The fifth was on February 20 near Santa Cruz Islands (12° S., 167° E.) and the sixth on March 27 was near the Aleutian Islands (51° N., 180°). Some of the other registrations were confused by microseisms of which the report gives some information.

DIET AND NUTRITION IN COLOMBIA*

BY DR. JORGE BEJARANO,
NATIONAL UNIVERSITY OF COLOMBIA

IT is impossible to make a detailed study of the status of nutrition in Colombia and determine the exact diet of the people because of the lack of information on the subject. No statistics are kept of the production and consumption of food articles, with the exception of meat and sugar. Therefore nobody knows what quantities of milk, bread, eggs, cheese, butter, fruits, vegetables and legumes are consumed annually. These figures could easily be obtained in the larger cities, but not in rural sections where there are no facilities for so doing.

In spite of the little information available, it can safely be stated that the Colombian diet is deficient as regards quality, standards, and method of preparation ; and that it is altogether too uniform.

The quality may be considered acceptable in many parts of the country. Bogotá and most of the higher cities have an abundant and wide choice of foods which are scarce in mild and hot climates, such as milk, bread, cheese, fruits, vegetables and legumes. The market-place in Bogotá is superior to those in European cities in its richness and variety ; but this advantage is wasted because of the dietary habits of the people, who lean toward sugary foods and starches. The national diet is unbalanced, lunch and dinner consisting mostly of starchy products and ending with a sugary dessert which upsets the digestion.

The Colombian method of cooking is also primitive and deplorable. The food is heavily coated with lard or fat, generally from pork or beef, and very hard to digest. To make things worse, there are no sanitary regulations or inspections to control the sale of food which, if eaten when adulterated or spoiled, may have serious consequences. This explains why in some areas—out in the plains, for example—meat is sold and consumed in a state of complete putrefaction. The markets of Támara and Ten, large towns in the cattle-raising area, sell 'marisco', meat from wild rodents (mostly Echimys), piled up in thin slices. It is nothing more than albumin in a state of decomposition. The plains people also have no sense of the nutritional value of milk, which is a paradox, considering the fact that they are in cattle country.

The dietary standards of the rest of the country are no better. Ignorance and indifference prevail everywhere and, in brief, the following conclusions may be made with respect to the Colombian diet : (1) too many starches and sweets ; (2) not enough albumin and fats ; (3) not enough milk or milk products ; not enough eggs ; (4) not enough vegetables and fruits ; (5) excessive consumption of alcoholic beverages in some regions ; (6) not enough calories (should be at least 3,000) ; (7) poor quality of certain foods, and lack of drinking water in about eight hundred towns.

---

* Substance of a paper read at the Eighth American Scientific Congress.

ORIGIN OF MAIZE*

BY DR. P. C. MANGELSDORF,
TEXAS AGRICULTURAL EXPERIMENT STATION

THERE have been three general theories regarding the origin of maize : (1) that it originated from pod-corn, *Zea mays tunicata*, which differs from normal maize primarily by a single dominant gene governing the development of a brittle, disarticulating rachis and the production of prominent glumes enclosing the seeds ; (2) that maize originated from teosinte, *Euchlœna mexicana*, a wild grass native to Guatemala and Mexico, by direct selection, by large-scale mutations or by the hybridization of Euchlæna with a grass now unknown ; (3) that Zea, Euchlæna and Tripsacum, the three American Maydeæ, have descended along divergent and independent lines from a remote common ancestor.

New evidence from cytogenetic studies at the Texas Experiment Station suggest that Euchlæna has had no part in the ancestry of maize, but is instead the product of natural hybridization of Zea and Tripsacum. Euchlæna, which is intermediate between Zea and Tripsacum in many characteristics, differs genetically from Zea primarily by four segments of chromatin, all of which have genes with Tripsacum effects. Hybrids of Zea and Tripsacum have shown that there is some association between chromosomes of the two genera and that interchanges of chromatin may occur. The combined data agree in pointing to the comparatively recent origin of Euchlæna as the result of natural hybridization of Zea and Tripsacum.

With Euchlæna eliminated from a role in the origin of maize, it is reasonable to assume that maize originated as a mutation from a wild pod-corn once indigenous, and perhaps still to be found, in the lowlands of South America. The primary centre of domestication probably occurred in the Andean region of Peru and Bolivia.

The hybridization of Zea and Tripsacum which occurred when the two genera were brought into contact with each other in Central America gave rise not only to the new genus Euchlæna, but also to new forms of maize which spread in both directions, almost completely replacing pure maize in all regions except the Andean. Cytological evidence on chromosomal knobs supports the view that almost all modern maize varieties are contaminated with Tripsacum.

The evidence from history, geology, palæobotany, archæology, ethnology, morphology, genetics, and cytology appears to be in harmony with this new interpretation.

---

* Substance of a paper read at the Eighth American Scientific Congress.

DEVELOPMENT IN THE MONOTREMES*

NEARLY a hundred and fifty years have elapsed since the first descriptive account of the Platypus aroused the interest and stimulated the curiosity of the zoologist. Not only did its peculiar external features prompt the name of *Ornithorhynchus paradoxus* proposed for it by Blumenbach, but the general resemblance of its female reproductive organs to those of birds and reptiles rather than to those of mammals suggested its probable oviparous habit.

Very soon, its near congener, Echidna, in spite of its widely different outward appearance, was found to possess the same essential characters. These characters not only led to their classification in the same proposed natural order, Monotremata, but also to their recognition as the only known members of a mammalian sub-class, later named by Huxley Prototheria.

After much conflict of opinion, full scientific confirmation of the fact of oviparity was only finally secured by Caldwell in 1884, and was dramatically announced in a cable message to the British Association of its meeting in Montreal.

Previous to Caldwell's scientific quest, there are no records of the scientific collection of specimens of early embryonic stages of Monotreme development. Even the material described by Caldwell (1887) and by Semon (1894), and that available to Wilson and Hill (1907), was insufficient to reveal more than the outlines of the earliest processes of Prototherian egg development.

The appearance, therefore, of a substantial instalment of their work on Monotreme development by Profs. T. T. Flynn and J. P. Hill (December 1939) is to be warmly welcomed. That work is based upon a relatively rich collection of rare material accumulated by the authors over a period of many years. The present memoir deals with the earliest phases of development of the ovum in both Ornithorhynchus and Echidna, and includes a description of the processes of oogenesis, maturation, fertilization and early cleavage.

Following a brief account of the breeding season and of ovulation in Echidna, a description is given of the intrauterine egg, and then of the laid (pouch) egg in that species. In the great majority of cases one egg only is brought forth, whilst in Ornithorhynchus, as a rule, twin eggs are produced and the shells of these are usually adherent to each other. In Echidna both ovaries are equally productive, while in Ornithorhynchus the left ovary alone is functional.

Oogenesis. The structure and growth of the ovarian oocyte are followed in detail through a series of phases. In the first phase the differentiation of the cytoplasm into peripheral and central zones is visible. The zona pellucida originates as a product of the ovarian follicular cells; a later distinct "striate layer" within the zona may either have a like origin or be formed from the oocyte itself. During the succeeding phase the zona is well established and the origin of yolk-sphere primordia in the cortical cytoplasmic zone can be recognized. During the next phase, active formation of definitive yolk-spheres sets in, at first from the periphery inwards, in the cortical cytoplasm: with the establishment of a typical latebral yolk-zone the formation of definitive yolk-spheres progresses from the latter zone in an outward, peripheral direction. This yolk-forming function of the latebra is discussed at some length together with the corresponding phenomena of the avian egg.

The authors confirm Caldwell's observation of the layer enveloping the oocyte named by him the "pro-albumen" layer, but they reject his interpretation of it as a precursor of the definitive egg-albumen of later stages. They show it to be a secretion of the follicular cells and regard it as the homologue of the liquor folliculi of the Graafian follicule of other mammals.

On the question of the origin and nature of the true albuminous and other constituents of the secondary egg envelopes, which are formed during passage of the ovum through oviduct and uterus, the observations of Dr. C. J. Hill are cited and confirmed.

Maturation. In both Monotremes this appears to be typical: the formation of each of the two polar bodies is illustrated in a series of remarkable figures on plates XIII and XIV. It is noteworthy that the second polar body—given off within the oviduct—was apparently formed independently of fertilization.

Fertilization. Until completion of maturation the germinal disk remains circular, but with the occurrence of fertilization a definite bilateral symmetry is established in the now elliptical area. Towards one end of the longer axis of the area the germinal disk is richer in its content of fine yolk-spheres than at the other, and the conjugating pronuclei lie nearer to the yolk-rich end of the axis.

Conjugation of the pronuclei is fully illustrated in the fine series of figures (74–83). Polyspermy does not normally occur in the Monotremes, although it would appear to be the rule among the Sauropsida.

Early Cleavage. The remainder of the memoir deals in detail with the phenomena of early blastomeric segmentation, the pattern for which is, of course, typically meroblastic.

The first cleavage furrow is transverse to the long axis of the elliptical germinal disk, that is, to the axis of bilateral symmetry. It subdivides the disk into two somewhat unequal areas, of which the smaller is markedly richer in yolk-sphere content. The two areas resulting from the first cleavage are thus dissimilar both quantitatively and qualitatively. The second cleavage is approximately at right angles to the first and coincident with the long axis of the germinal area. The third furrows are more or less parallel to the first and the result is "an eight-celled stage consisting of two linear aggregates each of four cells, symmetrically arranged on each side of the long axis of the disc, i.e., of the second cleavage furrow".

After the 16-cell stage, the arrangement of the blastomeric segments tends to become irregular, but shows a striking resemblance to the Sauropsidan pattern.

Although the bilateral symmetry of the pattern in the eight-cell stage is so evident, the authors do not consider it possible to determine, in the Monotreme, the relationship of the long axis of the unsegmented disk to the polarity of the embryo.

---

* "The Development of the Monotremata. Part IV. Growth of the Ovarian Ovum, Maturation, Fertilisation, and Early Cleavage." By Prof. T. Thomson Flynn and Prof. J. P. Hill. *Trans. Zool. Soc., London*, 24, Part 6 (December 1939).

Plates XVII–XXI of the memoir provide ample and brilliant illustration, both in surface and sectional view, of the earlier stages of blastomeric segmentation in the Prototheria, and lead one to anticipate eagerly the authors' future elucidation of the succeeding stages of development and above all of the beginnings of germ-layer differentiation.

Only those with some experience of the technical difficulties involved in the collection, preparation and sectioning of material at once both rare and refractory to treatment can fully appreciate the success with which those difficulties have been surmounted, as well as the excellence of the figures with which the memoir is so abundantly adorned.

UPWARD MOVEMENT OF SALT IN THE PLANT

Prof. D. R. Hoagland, T. C. Broyer and P. R. Stout of the University of California, Berkeley, read a paper dealing with the upward movement of salt in the plant, with special reference to the metabolic activities of roots, before the U.S. National Academy of Sciences at its annual meeting held during April 22–23.

Previous investigation has proved that accumulation of salt by the plant from the nutrient medium depends on aerobic metabolism of root cells. The relation of root activities in salt accumulation to movement of salt to the shoot has now been studied from several points of view. For certain purposes it has been necessary to conduct experiments over short periods of time with tracer elements, not initially present in the plant. Bromide ions and salts of the radioactive isotopes of bromine, sodium, phosphorus and potassium have been utilized. One of the authors (P. R. Stout) has developed technique for showing in graphic manner the general distribution of radioactivity in the plant by effects produced on X-ray films.

Several general cases of salt movement are recognized: (*a*) under influence of root pressure, (*b*) as affected by transpiration, (*c*) movement under conditions conducive to root injury produced by high salt (for example, sodium chloride) concentrations. Xylem exudates may build up very rapidly concentrations of salt much higher than those of the external solution. This may occur even before the roots have attained their maximum capacity for salt accumulation. The phenomenon is related to oxygen supply to roots, concentrations and kind of salt supplied, and indirectly to photosynthesis. Soluble organic nitrogen compounds and organic acid can also move in the exudate dependent on metabolic activities of the root and nature of salt supplied. The effects of $KHCO_3$ are particularly interesting in connexion with organic acid metabolism. Young active barley plants may absorb and translocate nutrient ions almost as readily in the dark as in the light, over brief experimental periods. Such plants may grow normally for some time with nutrients supplied only during the diurnal dark periods. With large plants, or those less capable of developing root pressure, rapid upward movement of salt depends on transpiration, which may thus indirectly influence absorption of salt by the root. Further evidence was obtained on the path and rate of upward and downward movement of phosphate by the use of radioactive phosphorus.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN THE DEPARTMENT OF ELECTRICAL ENGINEERING AND PHYSICS at the Coventry Technical College—The Director of Education, The Council House, Coventry (September 11).

ASSISTANT LECTURER IN THE DEPARTMENT OF MATHEMATICS—The Principal, Technical College, Huddersfield (September 12).

LECTURER IN CIVIL ENGINEERING—The Secretary, Technical College, Sunderland (September 16).

GRADUATE TEACHER FOR SCIENCE SUBJECTS, preferably with PHYSICS as a main subject—The Principal, Luton Technical College, Park Square, Luton (September 17).

IRRIGATION ENGINEER for the Government of Ceylon Irrigation Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9394) (September 27).

ASSISTANT TO TEACH ENGINEERING DRAWING, ENGINEERING SCIENCE, etc.—The Registrar, Technical School for Boys, Wimbledon, S.W.19.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 16: (a) The Genetic Interpretation of Plant Breeding Problems, by J. B. Hutchinson; (b) Inheritance of Quantitative Characters and Plant Breeding, by V. G. Panse. Pp. 34. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [138

Medical Research Council: Committee on Traumatic Shock and on Blood Transfusion. M.R.C. War Memorandum No. 1: The Treatment of Wound Shock. (Instructions produced in co-operation with the Army Medical Service.) Pp. ii+20. (London: H.M. Stationery Office.) 4*d*. net. [218

Other Countries

Report of the Forest Department of British Honduras for the Year 1939. Pp. 22. (Belize: Forest Department.) [158

U.S. Department of Agriculture. Technical Bulletin No. 711: Economic Status of the English Sparrow in the United States. By E. R. Kalmbach. Pp. 66+3 plates. 15 cents. Technical Bulletin No. 723: Biology of the Seed-Corn Maggot in the Coastal Plain of the South Atlantic States. By W. J. Reid, Jr. Pp. 44. 10 cents. (Washington, D.C.: Government Printing Office.) [168

Field Museum of Natural History. Anthropology Leaflet 34: Ancient Seals of the Near East. By Richard A. Martin. Pp. 46. (Chicago: Field Museum of Natural History.) 25 cents. [198

Imperial College of Tropical Agriculture. Ninth Annual Report on Cacao Research, 1939. Pp. 52. (Trinidad: Imperial College of Tropical Agriculture.) 5*s*. [198

Bernice P. Bishop Museum. Bulletin 160: Ethnology of Easter Island. By Alfred Métraux. Pp. vii+432+7 plates. Bulletin 165: Zonitid Snails from Pacific Islands, Part 2: Hawaiian Genera of *Microcystinae*. By H. Burrington Baker. Pp. iii+105–202+plates 21–42. Bulletin 167: Report of the Director for 1939. By Peter H. Buck (Te Rangi Hiroa). Pp. 42. (Honolulu: Bernice P. Bishop Museum.) [198

Occasional Papers of Bernice P. Bishop Museum. Vol. 15, No. 15: Four New Microcryptorhynchus from the New Hebrides and Caroline Islands (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 167–174. Vol. 15, No. 16: A New Variety of *Ruppia maritima* (Ruppiaceae) from the Tropical Pacific. By Harold St. John and F. Raymond Fosberg. Pp. 175–178. Vol. 15, No. 17: Additional Notes on the Archaeology of Fanning Island. By Kenneth P. Emory. Pp. 179–190. Vol. 15, No. 18: Scolytidae and Platypodidae of the Mangarevan Expedition. By C. F. C. Beeson. (Mangarevan Expedition, Publication 30.) Pp. 191–204. Vol. 15, No. 19: Notes on the Morphology and Sexuality of the Terrestrial Nemertean, *Geonemertes palaensis*. By W. R. Coe. (Micronesian Expedition, Publication 4.) Pp. 205–212. Vol. 15, No. 20: Notes on Micronesian Rubiaceae. By F. R. Fosberg. (Micronesian Expedition, Publication 3.) Pp. 213–226. Vol. 15, No. 21: The Genus *Ficus* (Moraceae) in Southeastern Polynesia. By V. S. Summerhayes. (Mangarevan Expedition, Publication 33.) Pp. 227–228. Vol. 15, No. 22: Hawaiian Plants named by Endlicher in 1836. By Harold St. John. (Hawaiian Plant Studies. 8.) Pp. 229–238. Vol. 15, No. 23: Some New Species of *Araucaricola* Lea from the South Pacific (Coleoptera, Tenebrionidae). By K. G. Blair. Pp. 239–242. Vol. 15, No. 24: Thysanoptera from New Guinea and New Britain. By Dudley Moulton. Pp. 243–270. Vol. 15, No. 25: Synopsis of the Genera of Hawaiian Cossoninae, with Notes on their Origin and Distribution (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 271–294. Vol. 15, No. 26: The Isopod Crustacea of the Hawaiian Islands (Chelifera and Valvifera). By Milton A. Miller. Pp. 295–322. Vol. 15, No. 27: Mosses of Southeastern Polynesia. By Edwin B. Bartram. (Mangarevan Expedition, Publication 34.) Pp. 323–350. (Honolulu: Bernice P. Bishop Museum.) [198

Tanganyika Territory: Department of Agriculture. Fifth Annual Report of the Coffee Research and Experiment Station, Lyamungu, Moshi, 1938. Pp. 40. (Dar es Salaam: Government Printer.) 1*s*. 6*d*. [208

U.S. Office of Education: Federal Security Agency. Bulletin 1940, No. 4, Part 1: Elementary Education—What is It? By Helen K. Mackintosh. Pp. v+31. (Washington, D.C.: Government Printing Office.) 10 cents. [218

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, SEPT. 14, 1940 No. 3698

CO-ORDINATION IN ADMINISTRATION

THE simultaneous issue of the tenth and eleventh reports of the Select Committee on National Expenditure (London : H.M. Stationery Office) has come very appropriately almost exactly a year after the outbreak of war, and provides an occasion for a survey of the progress made in co-ordinating the national effort.

The Select Committee has from the start steadily refused to be limited by any narrow conception of the term economy. Its eleventh report, detailing action taken on the second to eighth of the reports already issued by the Committee, together with the departmental comments on the Committee's recommendations, admirably illustrates the extent to which the Committee has already become a body of well-informed, responsible but disinterested critics of departments concerned with the economic direction of the War. Despite the extensive changes already being made in some directions that are leading directly to greatly increased production, there is a widespread opinion that the pace of our economic effort is by no means rapid enough, that it lacks drive and does not co-ordinate sufficiently for a real war plan the various phases of our economic effort.

These misgivings were not dispelled by Mr. Greenwood's recent review in the House of Commons of economic policy, with its admission that we are still in process of changing from peace to war economy. Although the present Government is not to blame for the deficiency, Mr. Greenwood afforded little evidence that it has really surveyed the consequences to the economic life of the country of a war of two or three more years, or that it is taking sufficiently energetic steps to achieve its objective of "a Britain completely mobilized economically into a public service, devoted to national ends and regardless of selfish interests".

The eleventh report of the Select Committee indeed affords more reassuring evidence of the Government's concern and activity in this field than is provided by Mr. Greenwood's speech. It is clear that the Government has been far from indifferent to this informed criticism. At the same time, there is evidence of undue departmentalism in a number of the comments upon the Committee's proposals, as for example in the Treasury's memorandum on the Contracts Co-ordinating Committee.

It may be remembered that in its second report, the Committee commented on the co-ordination of contract procedure, pointing out defects in the present organization and recommending the appointment of an officer of high standing and experience to act as chairman of the Contracts Co-ordinating Committee to bring order in the principles and practice of contract procedure, with duties including the examination and removal of general difficulties experienced by contracting firms. The Treasury's observations on this point betray the worst failings of departmentalism, for which the Civil Service to-day has been under constant criticism, and indicate a practical refusal to admit the need for co-ordination or the danger of a departmental mind in this matter. The counter-proposals that the functions of the permanent chairman should be limited and that he should be in fact the chairman of the Treasury Inter-Service Committee, are unlikely to be welcomed by the Select Committee.

If this example is far from being typical of Government reaction to the recommendations of the Select Committee on National Expenditure, it does indicate that this informed opinion needs to be strongly supported outside the ranks of the Committee if we are to obtain the wide vision and the receptivity to new ideas and new methods so essential in the elaboration of a real economic policy. Moreover, the question is closely allied to the whole set of problems known as 'priority', which are examined in the simultaneously issued tenth report of the Committee, on which departmental statements have yet to appear.

The tenth report of the Committee is an acute analysis of a vital part of war-time economic control, and the present priority organization is roughly handled. The name is indeed misleading, as priority, properly speaking, only describes one, and the less urgent, of the two distinct procedures involved. A community at war is faced with a shortage of all the factors of production, but it cannot permit the demand for materials and labour to be accommodated to the supply of them by the normal method of rising prices. It must provide first some mechanism of deliberate rationing and allocation, and then if necessary some system of priority. Allocation determines what shall be made; priority decides what shall be made first.

The report of the Select Committee performs a useful function both for the departments and for the public in keeping these two problems distinct. The elaborate machinery for priority, in the wider and looser sense of the term, which has been in existence since the outbreak of the War, has hitherto been concerned almost entirely with allocation. There was in fact no priority at all until June last, and since then there has been only a general Priority of Production Direction, merely notifying to industry two short lists of very broad categories of munitions most urgently needed.

The report urges, in effect, that this mainly negative conception should be replaced by a coherent system of allocation and priority, determining priority of production right down the chain from the War Cabinet decision to the factory. Only thus can we hope to eliminate the stumbling block which the independent attitude of war departments and competition between them presented in the War of 1914–18, and which in the Select Committee's opinion is developing again to-day. The Committee proposes, accordingly, that the Priority Organization and with it the Raw Materials Department and the Salvage Organization should be separated from the Ministry of Supply and placed under a separate minister, or a parliamentary secretary to the Ministry of Defence.

Whatever form the new organization may take, the sub-committee insists that it must be so constituted that it will command the respect of all departments and possess overriding powers in the field of priority and material comparable to those of the Treasury in the field of finance. These powers should be adequate to compel consuming departments, in cases where future difficulties of supply are foreseen, to modify their specifications or their quantitative requirements in advance of these difficulties. The allocation or rationing of materials would be applied in this centralized manner to every material that is scarce enough to form a bottle-neck in production.

In regard to priority, the Committee makes a further distinction. In the first place, priority directions are required based on detailed planning of the supplies and needs of the War Departments. While rapid changes of policy and so of requirements may be demanded, if factories are to be kept efficiently at maximum production, some limit is essential, and it is recommended that both planning and priority direction periods should be for not less than three months. In addition, however, the Committee recommends that a system of priority grading should be established, by which individual contracts which are delayed or obstructed could be given a specific priority.

The Committee also comments on the need for rapid improvement of the existing organization if the cost of the nation's effort is to be reduced to the minimum compatible with full efficiency. Recommendations are also made for the expansion and unification on an inter-departmental basis of the whole area organization for this purpose, for the appointment of departmental 'area progress officers' with knowledge of local and general production to work as part of the area organization, and for the submission of progress reports simultaneously to the area organizations and the department as well as for the establishment of progress branches in departments to work in close connexion with the principal priority officer and his staff.

The Select Committee in this admirable report has well earned the gratitude of the country for its lucid and scientific analysis of a detailed and laborious but essential aspect of the problem of economic co-ordination. In doing so, it has provided a noteworthy illustration of the way in which democratic institutions can adapt themselves to the demands of totalitarian warfare. It is reassuring to note from a memorandum by the Ministry of Supply included as Appendix 6 in the eleventh report that action has already been taken in regard to the reconstitution of the area boards and appointment of area progress officers.

It remains to be seen, however, how far the full inter-departmental control required has been established throughout all stages from Cabinet direction to delivery to the user to eliminate competition. The establishment thus of a national, as opposed to a departmental, outlook will ensure full efficiency in our economic effort. Moreover, only such a national outlook is capable of overcoming the numerous obstacles which departmentalism and sectional interests still present to the development of a really adequate economic policy, with all the repercussions this would have on many sides of our national life. If by the whole-hearted support which scientific workers, along with other sections of the community, afford to such informed and impartial criticism and analysis, whether or not it affects their own immediate interests, we can ensure the firm establishment of such a national point of view in handling all problems, we shall assuredly find that we have not only forwarded our immediate war effort, but also implemented the wise and far-sighted handling of the many problems of reconstruction which are so closely interlocked with the prosecution of the present task of national defence.

COPERNICAN LITERATURE

Three Copernican Treatises

The Commentariolus of Copernicus; The Letter against Werner; The Narratio Prima of Rheticus. Translated with Introduction and Notes by Edward Rosen. (Records of Civilization: Sources and Studies, No. 30.) Pp. xi+211. (New York: Columbia University Press; London: Oxford University Press, 1939.) 19*s*. net.

In the welcome expansion of interest in the history of science, which is now taking a more systematic and recognized form, one feature is the amount of attention devoted to Copernicus. Whether the ultimate effect will be to increase the stature of a rather legendary figure may be doubted, but it is all to the good that the original documents on which a critical judgment must be based should be made available in the English language. It is to be hoped that Mr. Rosen will persevere in his declared project to produce an English translation of the "De revolutionibus". In the meantime, he has given a translation of three treatises, two by the hand of Copernicus himself and the third the well-known account by Rheticus. The main work is all that is needed to complete the sources of information on the doctrines of Copernicus.

The "Commentariolus" is a short sketch of those doctrines written, apparently at an early date, by Copernicus himself. In several details it differs from the system ultimately adopted. But the only features of value, the revival of the ideas of Aristarchus and Heracleides, are clearly stated as explicit assumptions in this treatise, which for three centuries existed only in manuscript form.

The difficulty in accepting the traditional estimate of Copernicus is that apart from the central doctrine he was a complete reactionary. His real reason for taking even this step towards a true system remains, among the various arguments brought forward, far from clear. In the main he followed Ptolemy as closely as possible, and the chief difference is due to the fact that he was more Aristotelian than Ptolemy, and to that extent more in error. For him uniform motion in a circle had the nature of a categorical imperative, and this meant uniformity of motion relative to the centre of the circle. Now just as the eccentric circle represents a true approximation to a planetary orbit of small eccentricity, so uniform angular motion about the equant represents a genuine approximation to the law of areas. It is a most ingenious feature in the Ptolemaic theory; but to Copernicus it presented the most fatal defect because it was contrary to the teaching of Aristotle. This objection seems to have presented the strongest incentive to find an alternative to the Ptolemaic system. It seems to have had more weight than the only argument which was really valid in the circumstances, that from simplicity. The "Commentariolus" ends by assigning thirty-four circles to explain the motion of the planets, including no fewer than seven for Mercury alone.

The real merit of Copernicus was that, in the teeth of contemporary dogma, he attributed to the earth the motions of a rigid body. But this was not all. He not only affirmed the predominance of the sun, but he also asserted that the "eighth sphere", the sphere of the stars, was fixed and that it represented the true frame of reference. He further assigned to this sphere dimensions so vast that the "great circle", or earth's orbit, was insignificant in comparison, thus anticipating the criticism which Tycho Brahe afterwards thought insuperable. Thus the ecliptic was defined as the plane of the "great circle" and the polar axis and equator by the diurnal motion. There remained to be determined the motion of the polar axis itself, which means variations in the obliquity of the ecliptic and precession. The task was beyond the powers of that age, as it was to produce a satisfactory planetary theory. Copernicus has stated his view frankly:

"The situation is the same with respect to the motion of the eighth sphere. However, by reason of the extreme slowness of this motion, the ancient mathematicians were unable to pass on to us a complete account of it. But if we desire to examine it, we must follow in their footsteps and hold fast to their observations, bequeathed to us like an inheritance. And if anyone on the contrary thinks that the ancients are untrustworthy in this regard, surely the gates of this art are closed to him. Lying before the entrance, he will dream the dreams of the disordered about the motion of the eighth sphere and will receive his deserts for supposing that he must support his own hallucination by defaming the ancients. It is well known that they observed all these phenomena with great care and expert skill. . . ." And so his exaggerated respect for the work of the ancients plunges Copernicus into accepting their fictitious notion of 'trepidation'.

This characteristic passage occurs in the "Letter against Werner", the second document of which a translation is now given. Even Regiomontanus saw that the foundations of astronomy must be laid entirely anew. It is unnecessary to refer in greater detail to the treatise published by John Werner in 1522 at Nuremberg, or to this criticism of it by Copernicus. But it may be noticed that the question is one of the class discussed far more effectively a century later by Horrocks. Horrocks was a greater man than Copernicus, and he could profit by the progress which had been made in the intervening century. It may be that the earliest telescopic observations of position were not greatly superior to the old eye observations at their best, such as those made by Hevelius, for example. But they had the effect of disclosing the fallibility of observations in general and the necessity for careful attention to the conditions in which the observations were made. Confidence in the ancient records was quickly undermined, and astronomy was free to pursue its path unhampered by the dead hand of the past.

The third tract in the present set is the "Narratio Prima" of Rheticus, first published in 1540. This is chiefly familiar because it was added by Maestlin in 1596 to the first edition of Kepler's "Mysterium Cosmographicum", and has been reproduced in later editions of Kepler's works, as a convenient sketch of the Copernican system. The translation is therefore very welcome. The tract is the product of youthful enthusiasm by one who fell completely under the spell of the master. It is marred by one section full of astrological superstition, which may be pure Rheticus. But it still serves its original purpose, which succeeded so well that the sequel implied in the title was rendered unnecessary by the speedy appearance of the "De revolutionibus".

The translations are very freely annotated. The notes are devoted mainly to points of literary scholarship, and will be found valuable. Far less attention has been given to questions of scientific importance with which the text abounds. This is not a matter for complaint. What is wanted at the present stage is a clear version on which scientific discussion can afterwards be based. In the development of the history of science the collaboration of many minds will be needed. Only when the original texts become accessible in a familiar modern language will true scientific appreciation be really possible. The time when Latin could be contemplated as the one scientific medium, as Wallis conceived it in the seventeenth century, is now past. New conditions call for new methods, and here is an excellent sign that they will be forthcoming.

One or two comments may be made. The familiar formula σώζειν τὰ φαινόμενα (*apparentias salvare*) is bound to recur. Because the phrase "to save the appearances" has been used as an equivalent, something mean and unworthy is suggested, as though the article were absent. But surely the meaning is "to satisfy the observations", no more and no less, and in this guise the Greek idea ceases to present anything repugnant to the modern scientific mind.

A phrase of Rheticus "ad similitudinem pendentium in aere", to which parallel expressions occur in the language of Copernicus, leads the translator to comment, "Are we justified in attributing the pendulum to Copernicus? I think not". But many had seen the hanging lamp at Pisa before Galileo inferred the tautochronous principle, and that lamp was by no means the first pendulum. To reject the comparison of an astronomical libration with the motion of a pendulum is surely an example of gratuitous scepticism, for the figure would be natural and familiar in any age and in itself implies no scientific knowledge of any kind. The pendulum is no man's invention. It repeats an experiment which Nature places daily before men's eyes. The extraordinary thing is that before the days of Galileo no profitable lesson seems to have been drawn from it.

H. C. PLUMMER.

SOUTH AFRICAN BIRDS

The Birds of South Africa

By Dr. Austin Roberts. (Published for the Trustees of the South African Bird Book Fund.) Pp. xxxii + 463 + 56 plates. (London: H. F. and G. Witherby, Ltd.; Johannesburg: Central News Agency, Ltd., 1940.) 30*s.* net.

IN 1867 that versatile naturalist E. L. Layard published a small quarto book on the birds of South Africa, which then consisted of Cape Colony north to the 28th degree parallel south latitude.

In addition to his own personal knowledge and that of his friends, the author relied for information on the works of Le Vaillant and Sir Andrew Smith, who published large, expensive volumes at the end of the eighteenth and beginning of the nineteenth centuries. Some years later Dr. Bowdler Sharpe edited a revised edition of Layard's work and enlarged it to include the whole of the South African sub-region—the country south of the Zambezi and southern border of Angola. Then in 1899 appeared the first volume on birds in the "Fauna of South Africa" by Dr. A. C. Stark, who unfortunately was killed by a shell in Ladysmith in the latter part of that year, and the remaining volumes were completed by Mr. W. L. Sclater. For long this was the standard work on South African birds, but it is now quite out of date and difficult to obtain. The appearance therefore in 1937 of Dr. E. L. Gill's "First Guide to South African Birds" was very welcome, since it placed in the hands of the public a reliable and fully illustrated book at a moderate price. The present volume is on similar lines, covers a larger field and includes all the birds found south of the Zambezi and Cunene Rivers.

General Smuts has written a foreword, and he explains that the publication of the book was made possible by the South African Book Fund started in 1938 for the purpose of publishing works dealing with the ornithology of South Africa. He points out that this work is suitable for use in schools, the general public and the student engaged in studying the great variety of South African bird life. In his introduction the author makes some general remarks on the study of birds followed by a rather lengthy discussion, on the subject of nomenclature and classification, which seems rather outside the scope of the book. The remarks on distribution and variation direct attention to interesting problems in South Africa which still remain unsolved. Dr. Roberts divides South Africa into twenty-one sub-regions and briefly describes the characters of the country, the vegetation and the birds peculiar to each.

As the book is intended as a simple and concise guide, descriptions are in most cases omitted and the coloured plates have to be relied on for identification. These as a whole are good, but frequently lack the characteristic attitudes and are on the small side. The plate of the wading birds, for example, suffers from a similarity in all the figures, and possibly the artist did not know his subjects in the field and was therefore unable to exaggerate the important differences, which is rather necessary in small figures. It is unsatisfactory to attempt to show slight colour differences except by the most expensive reproduction, and Dr. Roberts has wisely supplemented some of the figures with brief descriptions. He believes in the multiplication of genera, and in some cases it is difficult to recognize species under the generic name used—for example, Spipola for the common tree pipit—but in every case the more generally accepted generic name is given as a synonym. In addition there are English, Afrikaans as well as native names, and a separate index for each at the end of the book—very convenient but rather extravagant as regards space.

The letterpress is of necessity concise, but Dr. Roberts has done it in an admirable manner and has something to say of the status, distribution, habits and nesting of each bird. We wish it had been possible to have included a few lines on field identification, which would be very helpful to beginners, and no one could have done it better than the author with his life-long experience in the field.

South Africa has a very varied bird fauna ranging in size from the ostrich to the penduline tits and sunbirds. Of the first mentioned we learn that the experiment of crossing the North African race with that farmed at the Cape to improve the feathers was never completed, owing to the demand for feathers ceasing with the advent of the motor-car! Only one species of penguin—the jackass—is endemic, but the rockhopper of the Antarctic seas is occasionally driven north on to the southern coast. Anyone who has been fortunate to make a voyage around the Cape must have noticed the numbers of albatrosses and petrels met with, and as many as thirty-two kinds are listed as occurring in these seas. The white stork migrates to Africa for the winter, and should there be plagues of locusts or caterpillars in the Union large flocks make their appearance and do useful work in destroying them. A few occasionally remain behind after the main body has migrated north; but they do not breed and are probably sickly birds.

A characteristic bird of the savanna veld is the secretary bird, which stalks gracefully about in search of snakes and other prey. It nests in low trees and the young do not leave the nest until they can fly. Dr. Roberts considers this an unusual habit for a terrestrial bird and suggests that it has come about because the young have very brittle legs! But surely the young of all birds, terrestrial or otherwise, which nest off the ground do not leave the nest before they can fly, except in the case of ducks. There is a long list of birds of prey and in spite of the opening up of the country the numbers of vultures have not greatly diminished, except in one or two cases. The same, however, cannot be said of the larger eagles which, owing to their depredations on farm stock, have been sadly reduced, though still common in the remoter areas. Many different kinds of francolins inhabit South Africa and show interesting geographical colour variation, while the Union might be described as the headquarters of the bustards, since no fewer than eleven species occur within the area, including that fine bird the kori or giant bustard, the gom-pou of the Dutch. Hornbills are well represented and one of the most interesting is the southern ground hornbill. Unlike other species it is to a great extent terrestrial, lays its eggs in a hollow in a tree, and makes no attempt to wall up the female on the nest; indeed the male assists in the incubation. It is found both on the veld and forested area and has similar feeding habits to the secretary bird, but moves about on the ground with waddling walk. These birds utter a booming call which the natives interpret as the female saying "I'm going, I'm going, I'm going home to my relations," the male replying, "You can go, you can go, you can go home to your relations!"

Three species of the well-known honey guides are found in the Union. These birds are unique in that they enlist the help of man to assist them in obtaining honey, while they call on other birds —barbets, woodpeckers and bee eaters—to hatch their eggs and rear their young!

The common cuckoo reaches South Africa in winter and so does the greater spotted cuckoo which in the northern nesting season is found from Spain to Persia. It also breeds in our winter in South Africa and lays in the nests of starlings, but as others are known to breed in the tropics, both north and south of the equator, there is probably more than one race and each migratory. Among the various other cuckoos are the beautiful emerald and bronze species, which are also migratory. The colies belong to a family unknown outside Africa and three different kinds are found in the south. From their habit of creeping about in trees and bushes in search of fruit and berries they are known as mouse birds.

The Eurylaimidæ or broadbills is a typical oriental family which extends into Africa, where it is represented by four species, one occurring in the south. In like manner the Pittidæ or ant thrushes are also eastern, but only two species have reached Africa and one which is migratory occasionally strays within the northern parts of the Union. The common swallow is a very numerous visitor to South Africa and the house martin as well, but in smaller numbers. The latter is said to breed there, but Dr. Roberts thinks further investigation is necessary. Curiously enough the winter quarters are still unknown of two of the common breeding species—the larger striped swallow, *Hirundo cucullata*, and the South African cliff swallow, *Petrochelidon spilodera*. The creepers are essentially a Palæarctic family, but an aberrant species, the spotted creeper, *Salpornis spilonota*, occurs in the plains of northern India and ranges from there through southern Abyssinia, the Sudan to Nigeria and south to Southern Rhodesia and Mashonaland.

The Promeropidæ or sugar-birds is the only family peculiar to South Africa and consists of only two species; one, *P. cafer*, is found in the Cape Province, while the other, *P. gurneyi*, is known from Natal and the country northward to Southern Rhodesia. These birds have a remarkable habit of performing an aerial dance over the protea trees when they are in blossom. The relationship of the family is uncertain but the nesting and feeding habits are not unlike those of sunbirds. Among the large family of warblers—Sylvidæ—Dr. Roberts mentions no less than nine species that breed in Europe and have been recorded from the Union at other seasons. Included in the family is the genus Apalis, which consists of four very variable species divisable into fourteen races. Then there are the fan-tailed warblers or cisticolas, recently monographed by Admiral Lynes. We notice that there is some difference of opinion between Dr. Roberts and Admiral Lynes as to which birds are to be considered species and which sub-species.

The last family is called by Dr. Roberts the Ploceidæ and this he divides into a number of subfamilies including the Fringillinæ—the true finches and buntings—considered by most authors a separate family. But surely in any event the name of the family must be Fringillidæ. Be that as it may, the family as now constituted contains a number of very interesting birds. There is that remarkable sociable weaver, which builds a very large communal nest occupying the whole of an isolated tree and inhabited by scores of pairs. Other species breed also in colonies, but construct retort-shaped nests, others again build round balls of grass supported on grass stems, while a few make their nests on the ground. In contradistinction to this variation in nest building one sub-family, the Viduinæ or widow birds, make no nest but lay their eggs in those of small members of the family. Among the true finches there is the Cape canary, *Serinus canicollis*, and a dozen or so others including the chaffinch now established in the Cape Peninsula. Among the buntings are three species of that widely distributed genus Fringillaria, or rock buntings, ranging from western India to the Cape.

This will prove a very useful work not only for the inhabitants of the Union but also to ornithologists throughout the world. It is much to be regretted that the size of the book had to be limited, and we trust that in the future Dr. Roberts will give us a history of the birds of South Africa.

N. B. KINNEAR.

PRINCIPLES OF MODERN BUILDING

(1) Building Design and Construction

With Reference to the New L.C.C. Regulations. By Felix James Samuely and Conrad Wilson Hamann. Vol. 1. Pp. xi + 350. (London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

(2) The Essentials of Reinforced Concrete Design

A Simplified Text-Book with Special Reference to both Old and New L.C.C. Regulations, and to the Code of Practice of the Building Research Board. By R. F. B. Grundy. Pp. xi + 134. (London: Chapman and Hall, Ltd., 1939.) 10*s*. 6*d*. net.

THE progress of research in all branches of the building industry has inevitably led to the development of new ideas in both design and construction, and to important modifications in recognized methods. In a report published in October 1938 on behalf of the Department of Scientific and Industrial Research ("Principles of Modern Building", vol. 1, Walls, Partitions and Chimneys) it was explained by Dr. R. E. Stradling, then director of building research, in a foreword, that the aim in preparing it was to set out a statement of principles to guide the practical man in adapting his designs to the changes which have been taking place. For about eighteen years, the Building Research Station has been investigating materials and methods and collecting data. Scientific developments, increasing experience and new trends in architecture have led to the codification of new rules, and there are now available for the guidance of designers and constructors the code of practice prepared by the Building Research Board and the new regulations of the London County Council.

Such a position makes necessary the provision of new text-books and hand-books on the branches of the building industry which are affected. Both the volumes referred to at the head of this notice take the new regulations as their basis. Indeed, the first mentioned may be said to have actually arisen out of them.

(1) The authors, finding it necessary to prepare a new set of explanatory notes, tables and sketches for use in the drawing office to meet the requirements of the authorities, took the public-spirited step of making them generally available.

In this, the first of the three volumes in question, the greater part is devoted to technical explanations of the by-laws, accompanied by sketches, tables, specifications and graphs. A section has been given to a short résumé of the enactments to which buildings in London must conform, and the final portion contains an important chapter on monolithy. Here the aim is to explain the monolithic action of continuous framework, so that the designer may be enabled to estimate stresses with sufficient accuracy to ensure that the material is satisfactorily distributed and the factor of safety is constant, or at least approximately so. The tables which are provided enable the work to be carried out expeditiously.

(2) It is on a more modest scale that the subject of the second book is presented, and it is intended more particularly to meet the requirements of those engaged in the design of the simpler types of reinforced concrete structures. By reason of its concise and practical method of presentation and the side-by-side development of theory and practice, it should also prove a text-book of real value to the student. The most important feature of a book of instruction is that it should give its reader a thorough and reliable grounding in its subject. In the case of such elementary problems as arise in columns, slabs, T-beams, retaining walls and foundations, it provides that measure of practical guidance that is most desired by the student or junior designer.

EMBRYOLOGICAL HISTORY

The Rise of Embryology
By Prof. Arthur William Meyer. Pp. xv+367+58 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 34*s.* 6*d.* net.

THIS book by the emeritus professor of anatomy at Stanford University is probably the most complete work on the history of embryology which has yet been produced. It deals both with the discovery of facts and with the growth of ideas, and what adds to its value is the free use that the author has made of the writings of early scholars and naturalists, who thus speak for themselves on the subjects which they investigated or discussed. To the modern student the authors of most of these works are often mere names and their writings are either inaccessible or difficult to obtain. The present work, however, by the liberal use of quotations, enables the embryologist to obtain first-hand information as to what the earlier writers really said and thought and thus to correct common misconceptions as to the value of successive contributions to the study of generation and development. Moreover, by reading these extracts one is made to appreciate something of the zeal and enthusiasm which these early investigators displayed in their studies of natural processes.

Prof. Meyer's volume covers much of the same ground as the smaller work by Dr. Joseph Needham entitled "The History of Embryology", but whereas Dr. Needham's account stops short at 1814 (the year of the publication of John's "Chemische Tabellen des Tierreichs"), in the present treatise the growth of some of the fundamental ideas is traced right down to the adoption of the modern points of view. Thus, it contains a chapter on the growth of morphology, including the discoveries and views of von Baer, a subject omitted from Dr. Needham's book, which was primarily an introduction to chemical embryology. Moreover, a good deal of space is devoted to the fertilization of the ovum, a study which strictly speaking is physiological rather than embryological.

The first chapter is upon the manner in which primitive man in all ages has been wont to regard the role of the sexes in generation, and it is shown that the relation between coition and conception is denied, or at any rate not realized, by some savages even at the present day. There follows a chapter on early historic ideas of generation. Here it is stated that among civilized people the dependence of procreation upon the testicles and ovaries was known in the earliest times. Not only was Aristotle aware of the effects of castration, as carried out upon cockerels, and of spaying as practised upon sows, but the same facts were known to the Chinese, who castrated boars and cocks and spayed sows for economic reasons so early as 1100 B.C. The third chapter deals with spontaneous generation, and contains a readable account of a controversy which ended with Pasteur's discoveries in 1861, although Bastian made an unsuccessful attempt to revive it some ten years later. It was quite natural that all earlier peoples should have accepted spontaneous generation upon the evidence available, but the question now is chiefly of historical interest.

The time-honoured controversy between the upholders of preformation and those of epigenesis occupies the next two chapters. The theory of preformation in its crude form has long been realized to be absurd, and it is merely a matter of amusement to read how certain philosophers estimated the number of miniature beings that should have been contained in the ovary of Eve at the Creation, and then attempted to calculate the time when an ovum or a spermatozoon would be finally depleted and the human race become extinct. The doctrine received apparent support in later times from the morphological investigations of distinguished men of science such as Malpighi, Swammerdam, Réaumur and Haller, and was not finally rejected until the discovery of the mammalian ovum and the contemporaneous researches of von Pander and von Baer. Nevertheless, it may be doubted whether in the light of modern concepts concerning the nature of matter and energy, and (within biology) the part played by organizers in development, the two views are really so fundamentally antagonistic as is usually supposed.

Following upon two chapters on exploded theories such as pangenesis and panspermia, there are entertaining accounts of the search for the mammalian ovum and the discovery, origin and meaning of the spermatozoon, and we read how many false trails were followed before the truth was reached. The following sections upon the evolution of ideas concerning fertilization, the nature of mules, and the formation of monsters contain much to interest the biological historian. Students of the development of biological technique will extract enjoyment from the chapter on early visual and other aids to investigation. In the final chapter the author shows that he fully realizes that Roux was not the founder of experimental embryology, since Harvey, Malpighi, Redi, Réaumur, Spallanzani and some others carried out experiments within this field in the seventeenth and eighteenth centuries. The more important of these and their bearing on the growth of embryology are herein described and discussed.

The book is well illustrated both by portraits of early biologists and scholars and by reproductions of illustrations from their works.

F. H. A. MARSHALL.

PUYALLUP-NASQUALLY

The Puyallup-Nasqually
By Marian W. Smith. (Columbia University Contributions to Anthropology, Vol. 32.) Pp. xii + 336 + 7 plates. (New York: Columbia University Press; London: Oxford University Press, 1940.) 33*s*. 6*d*. net.

THE Puyallup-Nasqually, who are the subject of Miss Smith's ethnographic study, are coast Salish of southern Puget Sound in the State of Washington on the north-west coast of America. Their habitat affords a striking example of the manner in which the geographical factor may enter into and condition social, political and economic development. The section of low land known as the Puget Sound area is one great watershed honeycombed by creeks and rivers, of which the Puyallup and Nasqually are two whose banks were formerly occupied by the people here under investigation.

Between the peoples of the river-valleys which run down the side of the mountain ranges there was little opportunity for inter-valley communication until the highlands were reached. Within the valleys the people lived in discrete village groups without any political bond whatsoever. The sole unitary concept was geographical. The river furnished the staple of subsistence, the salmon, and owing to the density of the vegetation in former days it afforded the only line of communication, mainly by canoe. Hence while the common occupation of the river-valley fostered a certain sense of unity, it was of insufficient strength to override the lack of common interests. There was no ownership of land even to the limited extent of hunting rights; and the basis of approach between communities or between individuals within the communities was "suspicion", which the ties of kinship only alleviated but did not remove. The social unit was the family living in a communal house containing four to six family groups. One such house, or sometimes two, constituted the village, sedentary in winter, and in spring, summer and autumn the centre from which excursions were made, never far afield, for hunting, fishing and gathering shell-fish.

Miss Smith's data were gathered in the field in 1935–36. By this time the Puyallup-Nasqually culture had gone; except for a small group living on the Nasqually reservation, the people now own their own homes and are scattered among rural and urban white, from whom they can scarcely be distinguished. The author, however, was fortunate in finding a number of aged informants, in whose lifetime the traditional culture had passed away. With the information elicited from these survivors she has been able to put together an arresting and detailed reconstruction of an illuminating example of the culture of the north-west coast.

When so much that is instructive in the light it throws on the economy of a primitive community has been rescued from oblivion with meticulous attention to the record of detail, it may seem invidious to select. It is worth while, however, to direct attention to the part played by prestige based upon wealth—a prestige in which the shaman as such does not share—in determining social status; the high degree of specialization in occupations demanding an individual technique and the development of skill, producing, among others, the professional shaman and the warrior or 'brave'; and the interpretation of every attribute of the individual in the light of religion, in which each individual characteristic was explained by a relationship with a supernatural 'power', which was very like a partnership—in fact, the relationship already more familiar to students of the North-West culture as that with the 'spirit-helper', or less correctly, as it was formerly put, 'individual totem'.

Miss Smith's inquiries have effectively covered every aspect of native life, economic and social, as well as material culture in the area of her investigation so far as these can now be recovered. Her account is a valuable contribution toward understanding of the North-West culture as a whole, which for so long has provided the anthropologist with a profitable and fascinating field for inquiry.

Sepia

By Dr. David H. Tompsett. (L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 32.) Pp. 184+25 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1939.) 12*s.* 6*d.*

THE new L.M.B.C. Memoir on the cuttlefish *Sepia officinalis* well maintains the tradition of a famous series, and it is assured of an especially warm welcome in that it fills a long-felt gap in the descriptive literature of type species. At last between two covers we have a reasonably detailed account of this magnificent invertebrate. The memoir follows the usual plan of the series, taking system by system with careful instructions for their dissection. An especially pleasing feature is the photographic reproduction of the original drawing made by Bell in 1787 from Hunter's injection of the circulatory and respiratory organs. The student will be grateful for the hypothetical primitive mollusc and for the adaptations from Naef to illustrate the evolution of the cephalopod shell. An appendix gives useful directions for preservation and injection.

The eighty-one illustrations comprising the plates are fully adequate for their purpose, although occasionally the shading is not altogether happy, in that it fails to give a convincing appearance of solidity. One would have liked a carefully drawn stereogram of the coelomic cavities imagined dissected and viewed from the side. Only one who, like Dr. Tompsett, has soaked his mind in the spatial relations of the parts could draw such a figure. It would have been constantly helpful to all who study Sepia, as indeed will be this memoir as it stands.

The Pinpoint Planetarium

By Armand N. Spitz. Pp. vi+86+24 charts. (New York: Henry Holt and Co., 1940.) 2 dollars.

THE existence of planetaria in several American cities has assisted in arousing interest in astronomy; but, as the author of this work points out, a planetarium lecture lasts only an hour and few people are able to attend regular lectures. The Pinpoint Planetarium has been designed for those who wish to commence the study of the stars, and, while making no pretence to completion or perfection, it is an initial step which renders it easier to proceed to more serious study.

The book presents two charts for each month, one showing the stars as the observer looks north, and the other the stars when facing south. Very clear directions are given about the method of cutting out the charts and bending them so that a dome is formed. By punching a hole wherever there is a dot, representing a star, and making each hole the size of the dot, the stars appear in their proper relative brightness. By holding the pinpoint planetarium up to the light of a window or lamp, the stars will appear as they are seen in the sky, bright points of light against a dark background.

A chapter is devoted to an explanation of the stars for each month and of the stories that the constellations illustrate. The planetarium does not show the planets, but in a chapter, "Some Sky Lights", rough positions of the planets are given for each month from 1940 to 1945. A glossary-index with the pronunciation of the names of the principal stars and of the constellations is a helpful addition to this useful production.

(1) The Photographic Process

By Prof. Julian Ellis Mack and Prof. Miles J. Martin. Pp. xvii+586. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 33*s.*

(2) The Photographer Speaks

By F. J. Mortimer, Dr. Olaf Bloch, J. Dixon Scott, J. E. Saunders, Marcus Adams, W. L. F. Wastell, Bernard Alfieri, Noel Griggs, H. N. Blinkhorn, Dr. D. A. Spencer. Edited by Dr. Olaf Bloch. Pp. 112+25 plates. (London: George Allen and Unwin, Ltd., 1940.) 7*s.* 6*d.* net.

(1) PROF. MACK and Prof. Martin are to be congratulated on producing for the first time a real text-book of theoretical and practical photography. It is unfortunate that, in Great Britain, photography is not taught but picked up, while it seems that in the United States it is taught to students who have not the necessary knowledge of physics and chemistry. Being produced in the United States, therefore, the book is very detailed, though with some loss of emphasis on fundamentals. It is not a book to sit down and read, but it will be of the greatest value to anyone who teaches the subject and as a reference book for libraries. The manual of practical exercises at the end increases its value. It is profusely illustrated and well indexed. For its contents, it is reasonably priced.

(2) The second book consists of a series of talks on the radio by distinguished photographers. They fail to do justice to themselves, and the additional illustrations do nothing to improve matters. The book cannot be recommended to any type of photographer and does, in fact, a considerable disservice to photography. A. S. C. Lawrence.

How to See Nature

By Frances Pitt. (Home-Front Handbooks.) Pp. viii+88+23 plates. (London: B. T. Batsford, Ltd., 1940.) 3*s.* 6*d.* net.

MISS PITT has designed this book especially for evacuees; her love and knowledge of the countryside is convincingly established, and should do much to encourage the beginner in natural history. The facts assembled, however, are presented rather as a series of snippets and afterthoughts which, while highly informative, would have been more useful to beginners if they had been set out in a more orderly array, and if greater attention had been paid to the rules of grammatical orthodoxy. Many of the plant and animal species are grouped together without regard to their abundance or rareness, which might lead to considerable difficulties for new inquirers into natural history lore. The book would be suitable for readers already possessing more than a passing acquaintance with events and happenings in Nature; perusal of the forty delightful photographs would do much to increase their appreciation. T. H. H.

SIR J. J. THOMSON, O.M., F.R.S.

READERS of NATURE will have learned with regret of the death on August 30 of Sir J. J. Thomson, Master of Trinity College, Cambridge, and professor of physics in the University. To those, and they are many, who have the honour of calling themselves his pupils, and to members of the College over which he presided, the news has brought a very personal sorrow. A man of rare intellectual gifts, and great personality, he was the acknowledged leader in the formative which laid the foundations of modern physics.

Born near Manchester on December 18, 1856, Joseph John Thomson was educated first at Owens College, Manchester. He entered Trinity College, Cambridge, in 1876 and was second wrangler, and Smith's prizeman in 1880, the senior wrangler in that year being Sir Joseph Larmor. Four years later, on the retirement of the late Lord Rayleigh, he was elected to the Cavendish professorship of experimental physics at the early age of twenty-seven, a post which he was destined to fill with great distinction for thirty-four years.

It was not unnatural that the early days of his professorship should have been occupied in consolidating and extending the electromagnetic theories of his great predecessor Clerk Maxwell. His investigations, however, convinced him that further elucidation of the relations between matter and electricity could only come from experimental investigations, and that the solution was probably to be sought in a close study of the phenomena which accompany the passage of electricity through gases at low pressure. In a brilliant series of experimental investigations, Thomson succeeded in showing that the cathode rays which stream from the negative electrode in such a discharge are charged particles, and further, by means of his 'electromagnetic balance' to measure not only their velocity, but also the ratio between the mass of the particles and the electric charge which they carry. This turned out to be only about one two thousandth of that for a hydrogen atom. A more fundamental unit than the hydrogen atom thus stood revealed—possibly, as Thomson surmised, an atom of pure electricity. The first public announcement of the discovery of the 'electron' was made by Thomson on April 30, 1897, at a Friday evening discourse at the Royal Institution.

The advent of the electron opened up a wide field for speculation and investigation, of which Thomson took full advantage. In particular, the experimental study of the fundamental structure of matter became an immediate possibility, and much of Thomson's thought and work were directed into that channel. The fame of Thomson's discoveries attracted many workers to the Cavendish Laboratory with whom he freely shared his ideas, and whose labours then, and afterwards, laid the foundations of many branches of modern physics. Thermionics, photo-electricity, and radioactivity sprang into being, and new light was thrown on many of the older branches of physics. This period of activity only died down with the advent of the War of 1914–18.

Thomson became president of the Royal Society in 1915, and in that capacity was largely responsible for the organization of the scientific war effort of the country. He afterwards played an important part in the formation of the Department of Scientific and Industrial Research. In 1918, on his appointment as Master of Trinity College, Cambridge, he resigned his Cavendish professorship. He was, however, immediately appointed to an honorary professorship by the University, and was able to continue in the Cavendish Laboratory those researches which had been the main preoccupation of his life.

It is impossible in a brief memoir even to summarize Thomson's many contributions to knowledge, or the still greater number which he directly inspired. Thomson was more than a great experimental scientist; he was a great teacher, and a great personality. The fame of his discoveries attracted to him a steady stream of young men from every part of the civilized world; but it was his personality which held them. He shared with them freely all that he had of inspiration and ideas; and together with Lady Thomson extended to them a gracious hospitality which lingers as a sweet fragrance in the memory. They responded with an admiration and affection deep and sincere. To them he was always "J. J.", and there was no one like him. It was Thomson's conviction that a university laboratory should not be a factory for turning out 'publications' but a training school for men. The student was there to learn his job by the slow and sometimes painful process of trial and error, and no haste for 'results' was allowed to short-circuit the process. If, as a result, the actual output of 'publications' from the laboratory was somewhat less than might have been expected, a stream of highly trained physicists went out from it, year by year, to carry on in many lands and in diverse positions the Cavendish tradition.

It was Thomson's lot to receive most of the honours and awards which can fall to a man of science. He was appointed professor of natural philosophy in the Royal Institution in 1905, and was awarded the Nobel prize in 1906. He was knighted in 1908. Universities and academies at home and abroad vied with each other to pay him homage. Each new honour was duly celebrated by his delighted students, but no honour could spoil or change him. To him the joy of discovery was ever its own complete reward.

Thomson lived long enough to see his great discoveries firmly incorporated in the very foundations of modern physics, to be recounted wherever physics is taught. He rests, as was meet and proper, in Westminster Abbey, but he still lives in the grateful memories of the many men whom he taught and inspired. J. A. Crowther.

When J. J. Thomson was appointed to the Cavendish chair of experimental physics in 1884, there was no little comment on the youthfulness of the new professor. It was, however, quite consistent with the fresh outlook on scientific research which was then prevalent, particularly at Cambridge. No one could be more fitly entrusted with the continuance of the work which had been begun by Maxwell, Rayleigh and others, and was now given a dwelling place at the Cavendish Laboratory. The man who could write a brilliant piece of mathematical analysis on the motion of vortex rings, and could link together mathematics, physics and chemistry in his daring book of 1886 was just the right man to give vigour to a new enterprise. Under his leadership and inspiration the Cavendish grew rapidly in efficiency and fame. His work was an illustration in full of the principle which he stated in 1893 in the preface to his "Recent Researches": "analysis works to the best advantage when employed in developing the suggestions made by other and more physical methods". At this time he had already begun to concentrate his inquiries on the phenomena attending the passage of electricity through gases; in "Recent Researches" he refers to the importance which Maxwell had already attached to the subject. Thomson's researches were conspicuously successful, and drew an increasing number of workers to a laboratory where inspiration and opportunity were so fortunately combined.

Surely there never was such a brilliant set of young research workers as in the Cavendish Laboratory in the nineties of the last century. Basing their work on Thomson's pioneering, and acting in close collaboration they explored new fields of research, to which Thomson's work on the ion and the electron led them. Rutherford was, of course, a member of that group, and his discovery of the principal properties of radioactivity must be associated with its labours.

Thomson was a powerful thinker, a fine experimenter, and an excellent expositor. His work will always be an international possession as well as a subject of national pride, and this will be not only because of the man himself, great individual though he was, but also because he opened the way for so many other of the great enterprises of modern science. W. H. Bragg.

It always seemed to me that Thomson's outstanding personal characteristic was a complete absence of pedantry. He carried a great weight of abstruse learning, but it was never intruded, and if a simple common-sense point of view was attainable, he always preferred it. His comments on things and people were simple and to the point, and although he had his likes and dislikes, he did not in the long run overlook merit wherever it was to be found.

Looking back on the career of his pupils, it may be fairly said that his judgments have been confirmed by events. He was always willing to let his pupils argue with him, and although he had an almost feminine love of having the last word, it was generally found that if anything really to the point had been said, he had tacitly adopted it a day or two later. I believe he will be held in affectionate memory by all who came in contact with him. Rayleigh.

J. J. Thomson was elected Cavendish professor in 1884 and I went into residence at Trinity College in 1886. Thus I am one of the few survivors who attended his lectures in those early days. I propose therefore to leave to others, better qualified than I am, the discussion of Thomson's epoch-making discoveries, and the history of the school of electrical and atomic physics formed by the many research students who, in later years, followed his lead into those fruitful fields of experiment. I wish instead to give some impressions of Thomson as a teacher, not in his own special line of work, but in the more general physics suited to the needs of an ordinary undergraduate.

I went to Cambridge with the intention of "reading science", but with only a very elementary knowledge of physics and chemistry, and a vague idea of what was to follow. If I had been asked, I suppose I should have named chemistry as my probable chief subject of study. But Thomson's lectures on properties of matter and electricity and magnetism opened to me an entirely new realm of thought. It is difficult to express the effect they made on a youthful mind with little knowledge but keen to learn. Thomson was not only a great physicist, but also a brilliant teacher, who could instil enthusiasm not only into those doing research, but also into more elementary students who went to him to learn some physics. So far as I am concerned, it was Thomson's lectures that made me turn unhesitatingly to physics as my chief subject of study. Though I owe much to others also, yet if at any time in an intellectually wandering life I could call myself a physicist, it was due to the teaching of J. J. Thomson.

W. C. D. Dampier.

Although all my life I have cherished the greatest admiration for the great physicist whose death the scientific world is mourning, my personal contact with Sir Joseph Thomson was almost confined to the one period, nearly forty years ago, in 1903–4, when I was working in the late Sir William Ramsay's laboratory in London. But to me it was a notable one, and it left the same enduring impression, felt and retained by all the youthful researchers then invading his laboratory at Cambridge, or indeed who have ever been his students, that "J. J." was on the side of the angels, meaning ourselves.

He had invited me to give a few lectures at the Cavendish Laboratory on the chemical aspects of radioactivity, and, horrible to relate, attended them himself as faithfully as the most conscientious first-year undergraduate. My embarrassment may be imagined, as it was quite impossible intelligibly to divorce the chemical from the physical aspect of the subject which he himself had so brilliantly established, and I was just about as comfortable as a classical lecturer would be if Homer had dropped in to hear about the Iliad. To what exactly I owed the unexpected honour I may never know, but it may be that the precipitation of thorium by ammonia was then almost as cryptic to a physicist as the deviation of the electron by combined electrostatic and electromagnetic fields was to a chemist. At any rate, I remember someone told me to illustrate as many as possible of the chemical operations on the lecture table, and that being done everyone seemed happy, and certainly the great man himself showed no inkling of the incongruity of the position.

At that time, and traces may still survive, I was somewhat sceptical about the electrical theory of matter; but as a sceptic it is a pleasure to recognize, as I hope I have done adequately in my popular writings, that from the chemical point of view the really fruitful idea which seems destined to survive, the idea of successive rings or shells of electrons in the atom, only the outer of which were chemically operative, dates from the earlier work of Sir J. J. Thomson and his model atom, rather than from the later ones incorporating it, and will always be a landmark in the history of chemistry. There may not be much in this field that will ultimately survive the test of time; but of this feature of model atoms I think we can already be reasonably sure.

Frederick Soddy.

Dr. F. W. Aston, in his graceful tribute in *The Times* of September 4, has, I think, recalled for all the research students of Sir J. J. Thomson what must have seemed to them one of the most striking and yet paradoxical aspects of their Professor's genius. "J. J.", though quite innocent of manipulative skill (witness the way Everett, his devoted assistant, used to shield his elegantly blown glasswork from even his master's caress) was, to my mind, unique in his ability to conceive some new experimental method or some way of overcoming practical difficulties. It was not that "J. J." despised the hard way of the manipulator since, for example, he usually advised his students to take a course of glass-blowing under Everett. I took this course myself, and I am sure I profited by it, but I always felt afterwards that its chief advantage was that one thereby made friends with Everett and, incidentally, gained an even greater appreciation of his own skill.

In my time, as a research student, just immediately before and after the War of 1914–18, the famous daily tea parties in the Cavendish Laboratory were still being held. The tea was made by Roff, who could claim a longer association with the Laboratory than the Professor himself, while the biscuits we understood were of exactly the same variety as had been provided in Maxwell's day. Here the gathering was usually international and the talk only rarely of physics. The Professor displayed a wide knowledge of the countries whence his oversea students had come and could usually draw them out in conversation by shrewdly informed questions.

When a scientific paper was in draft it was possible, by missing one's lunch, to engage the Professor's whole attention. Then he would work carefully through the draft, line by line, checking one's mathematics by alternative methods and generally making most valuable suggestions for simplifications and alterations of presentation, for, as he once pointed out to me, the writer of a paper is usually soaked in the subject, but the same cannot be said of all his readers. My own subject was not that in which "J. J." was specially interested, but the great depth and breadth of his knowledge of classical physics led him often to suggest for my use most illuminating analogies of experimental and mathematical treatment.

As an undergraduate, working for the Tripos, I had the privilege of listening to those stimulating lectures he gave under the title "The Electrical Theory of Matter ". These were far removed in style and structure from the usual formal lecture. The subject of his discussion might be that specially engaging his interest at the time or it might be the subject-matter of some paper, published here or abroad, which he felt was important. His lecture notes, I remember, were usually set out on a scrap of paper or on the back of an envelope. The theoretical treatment was rarely other than original, and was usually worked out as a miniature research starting from first principles. I treasure my own notes of those lectures to this day.

At Cambridge dinners "J. J." usually astonished his colleagues by his wide knowledge of men and affairs. Whether the topic were the cricket history of the northern (English) counties, or athletic records or Victorian novels, he was an amazingly accurate authority. Like most other Masters of Trinity his name will, I imagine, be associated with some *bon mot*. Personally I heard many such fall from his lips ; but I think the one which posterity will perhaps choose is his remark on the occasion of the meeting of the electors to some fellowship or research scholarship. Someone had been stressing the claims of a particular candidate, and after a longish eulogium sought to clinch matters by saying that when this particular candidate had written on a subject the last word had been said. "But", interposed the Master "perhaps we're looking for someone who says the first word".

In his speeches at Cavendish dinners "J. J." always stressed the value he set on friendships made in the Laboratory. Certainly there is something unique about the relationship between the professor and the student who sets out on his research career under him. For "J. J." the affairs of his own research students, both during and after their working period with him, were always matters of intimate concern. For the student, respect soon became blended with affection, which ripened as the years went on.

J. J. Thomson made the Cavendish Laboratory the world's focus of experimental physics in his time. Workers from all over the world came to listen to and learn from him. His personal contributions to his subject are unsurpassed, but he would, I imagine, wish his monument to be the loyal affection he inspired in the hearts of that happy band of workers who called him "the Professor" and who were called by him "my research students". E. V. Appleton.

In trying to assess the influence of J. J. Thomson upon the development of physics in Great Britain, two things stand out. The first of these was the completeness with which the important physics posts in the universities of this country and the dominions (and many abroad as well) in Government service, and in industry were filled by men whom he had trained. The record of research students working in the Cavendish Laboratory illustrates this in a striking way. The group of seven students in 1897 includes C. T. R. Wilson, J. S. Townsend and E. Rutherford. To select some names from the years which follow, there are McClelland, Langevin, Zeleny, R. S. Willows, H. A. Wilson, McLennan, R. J. Strutt (Lord Rayleigh), Barkla, O. W. Richardson, Horton, N. R. Campbell, Duane, Bumpstead, Laby, Kaye, Crowther, Vegard, G. I. Taylor, Thirkill, Whiddington, C. S. Wright, Aston, W. Wilson, E. A. Owen, T. L. Eckersley, Andrade, Norman Shaw, James, Appleton. The last pre-War group in 1914 includes his son, G. P. Thomson. The number of well-known names in this list is a witness to his achievement of making the Cavendish the most famous physics laboratory in the world.

The other feature of the Cavendish tradition which he created was the simplicity and almost crudeness of the apparatus with which his great experiments were carried out. Simplicity always characterizes pioneer research ; it is only in the later stages when a fuller development takes place that elaborate and costly apparatus becomes necessary. In J. J. Thomson's work the simplicity was carried to extremes. "String and sealing-wax" was no exaggeration, it was the Cavendish tradition as long as he reigned over it. Occasionally students coming from other centres smuggled into the Cavendish equipment on a more lavish scale, and I well remember as a young research student with what awe and envy we looked upon the possessors of pieces of apparatus which must have cost sums expressed in pounds and not in shillings. The theory of atomic structure was born in a tin can. This was characteristic of his genius. There can seldom have been a great pioneer who was so completely independent of the outside world of scientific thought and the conceptions current in his time. J. J. Thomson's school drew its inspiration from his mind alone, and in a few brilliant years started a new era in physics.

W. L. Bragg.

To contribute a personal note about the work and influence of Sir J. J. Thomson is for me a labour of love. But I would point out that it is written in a hurry with no time to look up references, rather under battle conditions, with air raids in operation a good deal of the time ; and if there is anything in it that anyone disagrees with, I am prepared to discuss it later on when times are quieter.

"J. J." was a great investigator. His methods were his own but in his hands they were effective. He made many important discoveries ; I will only mention two.

He will be immortal as the discoverer of the electron. There were others who were on the fringe of this, but he was the only one who realized that what he had made was a revolution. The others regarded what they were doing as a passing incident, but he followed it up and developed it. It is now the foundation stone of our ideas of the structure of the universe.

In 1881, he wrote a paper in which he showed that a moving electric charge possessed a mass solely in virtue of its energy of motion. This was the birth of the idea that mass was in some sort a measure of energy : a result which is generally attributed to Einstein. But a good many masons, notably Larmor, worked at that building before Einstein pointed at it.

My main impact with Thomson started in 1900, when I graduated at Trinity College and started working in the Cavendish Laboratory. His personality seemed to me terrific, and it was. After six years I felt that if I stayed there much longer I should not have any personality of my own left and in 1906 I went to Princeton.

"J. J." was a good lecturer, but his lectures always seemed to me more like a barrister's brief than a model of scientific reasoning. It was not that way he built up so many supercharged investigators. The main thing was his vital personality, his obvious conviction that what he and we were all doing was something important, and his camaraderie. His knowledge of athletic records was incredible ; he was a veritable Wisden of all the sports. Also seeing the important results he obtained with rather poor apparatus encouraged us to persevere in our efforts with the very inferior equipment of the Cavendish Laboratory at that period. No doubt the time also was opportune, but he was the man for the time.

This is a difficult analysis really, but whatever it was and however it happened he built up at the Cavendish Laboratory the greatest school in experimental physics that had ever been built up anywhere until that epoch. It would exceed the limits of this article to write out a list of those who achieved high distinction and there is also the difficulty of deciding just where to draw the line. But I can mention a list of names which express a definite fact and that is those of his pupils who have been Nobel Prize winners. The award of these prizes started in 1901. He himself was awarded the prize for physics in 1906. The Nobel Prizes awarded to his pupils were : Rutherford (1908), W. L. Bragg (1915), Barkla (1917), Aston (1922), C. T. R. Wilson (1927), O. W. Richardson (1928), G. P. Thomson (1937). There is no one else who can show a list of eight Nobel Prizes awarded to him and his pupils during his lifetime and it is unlikely that there ever will be. All these people actually received the important part of their training under "J. J." and in the Cavendish Laboratory.

He was a great inspirer. I cannot think of any other man who, in such measure, did so much intellectual good to so many others in his own lifetime. Owen W. Richardson.

Some forty years ago while studying physics under Poynting at Mason College I first met the great "J. J.". Though with no inkling of his future decisive influence upon my life, I was impressed with his striking personality. Eager desire for knowledge burnt in him like a fire, and he had the happiest knack of kindling it in others. His remarkable work "Conduction of Electricity through Gases" must have been an inspiration to many. It certainly was to me, and stimulated my research on vacuum discharge which ultimately took me to Cambridge to be his research assistant during 1910–13. Although this was comparatively late in his career as Cavendish professor, his fertility in ideas still appeared to be inexhaustible and supplied the whole laboratory with subjects for research. Still more amazing, and to me akin to magic, appeared his intuitive ability to diagnose the cause of trouble in an apparatus without working with it, for he had no manipulative skill.

"J. J." was an excellent lecturer with a voice that, on occasion, could surmount any acoustical difficulties or, more accurately, blast its way through them. Presiding at tea-time he was immense, and many of his pupils have since recounted how stimulating was his talk on all manner of subjects. Next to his natural kindliness, the character which endeared him most to the townsfolk of Cambridge, and gave rise to so many amusing and apocryphal stories, was that of the absent-minded professor careless in habit, wrapt in deep thought, gazing with unseeing eyes into the most unsuitable shop-windows. But beneath this dreamy exterior lay a shrewd North Country efficiency with which he ran, on a minimum outlay, his great laboratory, producing in a steady stream distinguished occupants for the chairs of physics in universities all over the world, a world which was just awakening to the vast and imminent importance of the subject. These men, when confronted with the gigantic engineering teamwork of modern high-voltage plants, may well look back, sometimes with regret, to those simpler days of gold leaves, tobacco tins and sealing-wax. His was a splendid life covering as it did that most prolific period of scientific renaissance inaugurated by argon, X-rays, and his own discovery of the electron. His passing marks the passing of an era. F. W. ASTON.

IT is not easy even to recapture any adequate sense of the influence which J. J. Thomson exerted on science in schools in the earlier days of this century. Electrons and J. J. Thomson were spoken of mysteriously by physics masters with the same bated breath. He came into my life, as into those of so many others, long before I came up to Trinity, when as a schoolboy I got hold of a copy of the "Discharge of Electricity through Gases", devoured it, found it much too hard to understand, resented especially its use of integral signs (which I had not yet "got to"), but gained such thrills from the parts I could understand that I even read it on Sundays, and found it worth the rebuke I received at home for violating the Sabbath. It sent me to his early *Phil. Mag.* papers of 1880 or so, on the stability of rings of charged corpuscles inside a sphere of the opposite sign of charge. One may be allowed to recall that "J. J." was a mathematician before he was a physicist. Afterwards, when one had come up to Trinity, one heard it rumoured that "J. J." liked doing his mathematics for himself, but that when in difficulties he had recourse to "J. L." next door.

As an undergraduate reading not physics but mathematics, one's contacts with him were indirect; one envied those who brought tales of his lectures at the Cavendish on "Properties of Matter", or the research students who brought tales of the laboratory teas there. One set of pictures, however, remains: those of "J. J." regularly attending Sunday evening chapel in Trinity, coming in at the very last moment, with surplice and M.A. hood, standing at the right moments with these articles of dress peculiarly crooked, and looking as if his soul were far away—a notable contrast to his saintly looking predecessor in the Master's pew. Later, one got to know and be thankful for his kindly courtesy to junior fellows, for the avoidance of whose awkwardness he so readily provided conversational opportunities, covering up one's more unusually fatuous remarks with the characteristic resonant half-grunt, half-laugh that concluded his own sallies. He had withal a somewhat disconcerting directness of suddenly asking a question pertinent and penetrating, amidst the vagueness of introductory conversations; and his face, previously turned aside as though interested (as in Chapel) in things miles away, would gleam with enjoyment as he thought of some teasing but kindly remark to make about the common acquaintance he had inquired after. His best story about physicists can scarcely yet be re-told, for the protagonists are still living; but the pungency of his description of the final interview between those heroic figures was worthy of the tradition maintained by masters of Trinity: "both were speechless, the one silent from rage and the other for the usual reason". On one of the occasions on which I heard him tell this story he slyly added: "And when one of them later wrote a book about physics, and NATURE asked me to review it, instead of doing so I filled in the little empty space at the bottom with the name of the other". History does not record whether NATURE took that advice, whether if so the review was written, and if so again whether it was printable. Thus did "J. J." make his open study on late Sunday evenings a place of scientific gaiety. E. A. MILNE.

IT was Prof. J. J. Thomson's name which took me to Cambridge in 1906. His lectures on electrons and the structure of matter introduced me to a domain of observation and thought new to me, and deflected my interest from more abstract mathematics to the atomic and sub-atomic world. It is not easy to describe the nature of the fascinating influence of Thomson's teaching. There was nothing sensational about it; but the apparent simplicity of the experiments and the straightforwardness of the explanation carried a striking power of conviction. When I left Cambridge I was converted to physics.

More than fifteen years later, on a visit to Cambridge, I met Thomson's son, who took me to the Cavendish and into the basement room where "J. J." was working, surrounded by the usual complicated structures of apparatus, glass tubes and wires. I was introduced: "Father, here is an old pupil of yours who studied with you years ago. . . ." The grey head, bent over a glowing vacuum tube, was lifted for a minute: "How do you do. Now, look here, this is the spectrum of . . .", and we were in the midst of the realm of research, forgetting the chasm of years, war and after-war, which lay between this rencontre and the days of our first acquaintance. This was Thomson in the Cavendish: science personified. But this fanatical objectivity did not conceal the human side of his nature, that of a man of the highest culture, of sound practical wisdom, of great kindness of heart.

Again, many years later when, expelled from my own country, I was invited to Cambridge, I found in Thomson's home, the venerable 'Lodge of Trinity', the kindest hospitality and friendship. It is to express my deepest gratitude for all he has done for me, in science and life, that I write these lines. Max Born.

Dans l'autre lutte, celle que l'homme livre contre l'inconnu, un combattant vient de disparaître, qui lui avait consacré toute sa vie. En d'autres temps, les figures les plus illustres de la science contemporaine seraient venues s'incliner devant sa dépouille, et auraient rappelé en termes appropriés l'influence de Sir J. J. Thomson sur tant de domaines de la physique et de la chimie modernes, dans tous les pays. La France en particulier, dont les savants doivent tant à l'œuvre de J. J. Thomson, aurait apporté, par la voix de mes maîtres, son hommage au grand savant qui vient de mourir. Hélas, parmi les savants français qui auraient pu le mieux prendre la parole en ces circonstances, les uns, tels que Marie Curie et Georges Urbain, sont morts prématurement ; les autres malheureusement, ne sont plus à même de nous communiquer leurs sentiments.

C'est donc à moi, leur humble élève, exilé sur la terre libre, que revient l'honneur de venir dire aujourd'hui ce que J. J. Thomson représentait pour la science française. Si j'ose l'entreprendre, c'est que j'ai la certitude de pouvoir le faire au nom des maîtres que j'ai cités, car ce sont eux qui m'ont appris à connaître et à respecter le grand savant anglais.

J. J. Thomson était Docteur ès Sciences de la Sorbonne ; il était membre de l'Académie des Sciences de l'Institut de France et Lauréat du Prix Mascart. Mais son influence sur la science française a été bien plus grande que ne peuvent l'indiquer ces trois symboles.

Né en 1856, J. J. Thomson a été l'un des artisans de la prodigieuse évolution de la physique qui a commencé à la fin du siècle dernier. Ses travaux sur la décharge électrique à travers les gaz (1897), contemporains de la découverte de la radioactivité en France, ont permis avec elle le développement de la physique atomique puis, plus tard, de la physique nucléaire. Son œuvre, en ce qui concerne la structure corpusculaire de la matière, est étroitement associée à celle de Jean Perrin, de Paul Langevin, et l'on sait quels fruits a porté cette influence, dans le domaine de la connaissance humaine.

Au nom des travailleurs scientifiques français qui ont pu venir en Angleterre reprendre leur place au combat, au nom de mes maîtres empêchés, au nom de la science française, je m'incline devant la mémoire de J. J. Thomson, l'un des plus grands physiciens du monde. Je prie sa famille, en particulier son fils et continuateur, George Paget Thomson, F.R.S., et sa fille et collaboratrice, Miss Joan Thomson, de recevoir ici, en même temps que Lady Thomson, l'expression des condoléances françaises unanimes, sinon unanimement exprimées. X.

Proposing a vote of thanks at a meeting of the British Association a few years ago, Sir Oliver Lodge described Sir J. J. Thomson as "a man whom posterity will envy us for having known". It is not often that one great man of science finds a perfect phrase in which to express his admiration of another, and the moment is doubly appropriate for putting on record this tribute.

E. H. Neville.

MISCEGENATION IN SOUTH AFRICA*

It is a matter of general experience that racial questions are rarely debated on their merits. In the discussion of the effects of inter-racial breeding among the different varieties of the human stock, the issue is commonly determined by prejudice masquerading as pride of race or political and economic considerations more or less veiled in arguments brought forward in support of a policy of segregation. No appeal is made to what should be the crucial factor, the verdict of science; and the existence of 'superior' and 'inferior' races which when crossed produce an offspring inferior in character to the superior parent is tacitly assumed. Such indeed was the experience of the Commission on Mixed Marriages in South Africa appointed by the Governor-General of the Union of South Africa to examine whether such marriages were likely to be detrimental to the future welfare of the population.

---

* Report of the Commission on Mixed Marriages in South Africa. Pp. 56. (Pretoria : Government Printer, Union of South Africa, 1939.) 3s.

While condemnation of such marriages was found to be universal among those whose evidence was sought, this opinion was based, the members of the Commission found, upon desire to ensure white hegemony in South Africa, or among the more enlightened of the native population on a racial pride, which resented the degradation of their womenkind. Even the members of the Commission themselves in one incidental reference hold the findings of scientific investigation as too inconclusive to assist their deliberations; and one member, Mrs. N. B. Spilhaus, alone in an individual minority report, has so far the courage of her convictions as to suggest that an infiltration of native blood of long standing may have promoted in the 'white' population a tolerance of an African climate, while averting evils of inbreeding now apparent in sections of the population which have more successfully preserved their racial purity.

The terms of reference of the Commission were in the first place to inquire whether mixed marriages between Europeans and non-Europeans (native, coloured, or other) were on the increase or are likely to increase; and secondly, as mentioned above, whether such marriages are sufficiently numerous to be seriously detrimental to the welfare of the Union and the future composition of the population.

The Commission, on opening its inquiry, found itself faced with a number of problems, such as definition, official classification for purposes of marriage and the accuracy of the resulting statistics, which, important as they are, must be passed over here. It was found that in the period 1925–1937, for example, the period immediately preceding the passing of the Immorality Act (1937) which made illicit intercourse between Europeans and natives a criminal offence, mixed marriages of all types showed a decrease from 133 or 0·9 per cent to 101 or 0·4 per cent. An increase in marriages between Europeans and coloured in 1935 and 1937 is thought possibly to be an after-effect of the economic depression of 1930, which led to impoverished Europeans and coloured living in close propinquity and thus tending to create conditions favourable to mixed marriages in the younger generations.

While mixed marriages between Europeans and coloured or native are widely disapproved among the public and in the churches, they are not as yet forbidden, save only by implication in the Transvaal, where, there being one law regulating marriage between whites and another for those between non-Europeans, there is no such provision for the mixed marriage which by tradition among the Voortrekkers and their descendants has been regarded as beyond contemplation. The Commission recognizes the great strength of public opinion in South Africa against mixed marriages, but points out that it is not universal and in fact has failed to prevent such marriages. Certain ameliorative measures in social conditions are recommended which should check the tendency to the contracting of such unions and check an increase otherwise probable, but the Commission holds also that "legislative action making mixed marriages impossible should be passed, and that it should be accompanied by other measures directed against illicit miscegenation".

The latter of these two recommendations is particularly stressed by the Commission. Obviously the problem is not the mixed marriage *per se*, injurious in individual instances as this may be, but "the coming into being of a group not only itself unhappily situated in the existing social structure of the country, but also forming a serious social problem"; and it is added—"The gravity of the situation is increased by the occurrence of a large amount of illicit miscegenation". Illicit intercourse indeed, notwithstanding repressive measures and influences, is the main source of miscegenation. If, therefore, legislation is framed as a guard against mixed marriages, it will be of little effect in countering miscegenation unless supplemented by legislation prohibiting extra-marital intercourse between the same class of persons.

In recent years two bills have been introduced and debated in the legislature but did not pass into law which had as their object to check the growth of miscegenation through the elimination of the mixed marriage. The trend of the arguments were on these occasions, like the outlook adopted here by the Commission, sociological not biological. The undesirability of the product of the mixed marriage, assumed to be racially inferior, is in fact an outcome of its social, economic, and political environment—conditions imposed in the interests of its own white hegemony by a minority of 20·9 per cent against a majority of 70·1 per cent non-European of which 68·8 is native. In other words, out of a total population of 9,589,898, Europeans number only 2,003,857 and 6,596,689 are natives. Even more significant for the specific problem with which the Commission dealt is the fact cited by Mrs. Spilhaus that there is an excess of 17,686 adult European males over adult European females.

The Commission recognizes that its recommendations would differentiate between Europeans and non-Europeans, but states that they are intended in a sense which "would not discriminate in a way unfavourable to the true interests of the latter".

OBITUARIES

Mr. R. C. Mossman

THE death of Robert Cockburn Mossman at Buenos Aires on July 19 removes a natural genius whose scientific instincts found their full expression without the help of a formal scientific training.

Mossman was born in Edinburgh on November 7, 1870, was educated at the Royal High School and entered his father's business, for which he had neither liking nor aptitude. I met him first when he was a boy spending every penny he could get in equipping a second-order meteorological station in his father's garden, and he kept up continuous records there from 1886 until 1900. Dr. Alexander Buchan was quick to recognize Mossman's gifts and encouraged him to make the most of them. One of his earliest labours was an elaborate study of the climate of Edinburgh, which was followed later by a still fuller treatment of the climate of London. He frequently assisted at the Ben Nevis Observatory, often acting as temporary superintendent, and he carried out a series of comparative observations in a hut high up in Glen Nevis, where he lived alone for a year in 1901–1902. He was elected a fellow of the Royal Society of Edinburgh almost as soon as he came of age.

He joined the Scottish Antarctic Expedition under Dr. W. S. Bruce in 1902, taking charge of the meteorological and oceanographical work on the first cruise in the Weddell Sea. While wintering in 1903 at Laurie Island in the South Orkneys, Mossman set up a meteorological observatory on shore, and rather than break the continuity of the record he remained while the *Scotia* made her second trip to the Weddell Sea and so passed a second winter in great discomfort in the miserable climate he was determined to study. Thanks to his representations, the Argentine Government took over the observatory as a going concern, and Mossman paid a visit to Grahamland in the gunboat *Uruguay* to look for Charcot, who was then missing.

Short trips in whalers to Spitsbergen and the Greenland seas occupied the next two seasons and in the intervals he was joint author with two of his colleagues of "The Voyage of the *Scotia*".

Returning to Buenos Aires Mossman spent six years in the Argentine Meteorological Office while Mr. W. G. Davis was director. When my eyes broke down in 1913 I was fortunate enough to have his help for a year in the editorship of "British Rainfall", and he remained in Great Britain until after the War.

Returning to the Argentine in 1920, Mossman filled several posts in the Argentine Meteorological Service in Buenos Aires and Cordova, being acting director in 1928–29 and receiving the appointment of head of the Climatological Department in 1930. He made a profound study of the climate of the southern continents and their relation to the Antarctic regions. The labours of an enthusiast for a life-time necessarily produced a flood of papers and memories. Including official reports, these could not number much less than a hundred.

In 1918 Mossman received the Keith Prize of the Royal Society of Edinburgh for his Antarctic work, and he also received the Gold Medal of the Royal Scottish Geographical Society. He did not concern himself with meteorological theory, but he had no superior in conscientious and tireless labour in the accumulation and orderly presentation of the observational facts on which all theory must be based.

HUGH ROBERT MILL.

Mr. C. H. Turnor

MR. CHRISTOPHER HATTON TURNOR, whose death occurred on August 19 at the age of sixty-six, was well known for his active interest in the science and practice of agriculture. He was educated at Christ Church, Oxford, and then specialized in agriculture at the Royal Agricultural College, Cirencester, where he was one of a remarkable group of students that included also Lord Bledisloe; afterwards he proceeded to organize and develop the considerable estates he inherited from his uncle. Throughout his life he was indefatigable in studying the possibilities of using more science in agriculture, and his sound common sense and instinct for practicability helped him to select those methods most likely to be of value and to concentrate on them. Early in his career he became greatly impressed with the possibility of lucerne growing and he introduced this crop with great success into his system of farming. He also studied in detail the Danish methods of agriculture and engaged the services of an expert Danish farmer to run one of his farms on Danish lines so that he and other agriculturists might be able to see how far they embodied improvements likely to be useful in English conditions.

His interests were very wide and he was unusually well read. He travelled a good deal but never failed to keep his farmer's eyes open, and he invariably brought back a crop of new ideas and suggestions for the improvement of British agriculture by the introduction of some of the methods he had seen. His account of the Pontine Marshes is typical of his travel writings: vigorous and enthusiastic, and punctuated with many shrewd observations about the cultivators and their ways of doing things. His writings on English agriculture included "Land Problems and the National Welfare"; "Our Food Supply" and "The Land and the Empire", in all of which he urged the adoption of a more coherent plan of land utilization in which the landowner should play the part of organizer and leader, with the farmer and farm worker fitting into the scheme as producers. He had no use for the idle rich or for the man who simply extracted money or pleasure from his estate; his view was that the landowner had a definite place in English country life, with clear-cut duties and responsibilities for which he should train himself and on which he should act. His house was always open as a meeting place for those genuinely desirous to improve country life, and he and Mrs. Turnor were delightful and unforgettable hosts whose influence extended much farther than they realized. Few men strove more conscientiously to live up to their ideals than he did, and one can safely say that if more landowners had been animated by the same high purpose, and laboured with the same success as attended him, the history of British agriculture would have been very different. E. J. RUSSELL.

Dr. R. Hanitsch

DR. RICHARD HANITSCH died at Oxford on August 11 last. Born at Grossenstein, Germany, in 1860, he graduated Ph.D. in the University of Jena. During 1887–1895 he held the post of demonstrator in zoology in the University of Liverpool. During this period he took an active interest in marine biology and became an authority on the sponges, a group on which he wrote a number of papers and reports dealing with English, Irish and some of the foreign species. He also contributed, for a few years, the sections dealing with the literature on sponges and Protozoa to the *Zoological Record*, ending in about 1894. Dr. Hanitsch also contributed short papers on other zoological subjects including the pineal eye of Anguis and the structure of Limax. The two last-named were printed in the Liverpool Biological Society's *Transactions*.

From 1895 until 1919 he was director of the Raffles Museum at Singapore and during this period he became interested in Blattidæ. He contributed various papers on their systematics and continued the study of these creatures until about a year before his death. Dr. Hanitsch was also interested in numismatics and wrote several articles on this subject. In 1892 he married Miss Ethel Vernon of Liverpool and had five children. A. D. IMMS.

Dr. R. Hanitsch came to Oxford after the War of 1914–18 and in the Hope Department of the University Museum continued his studies of Malaysian Blattidæ until failing health finally prevented further work in 1939. At the time of his death, papers on the Blattidæ of New Guinea, Federated Malay States, and Borneo were well advanced. He had written thirty-two papers on Blattidæ, mainly oriental, in which 17 new genera and 218 new species were described. As a result of this work, and the previous work of Mr. R. Shelford, the Hope Department became well known as a centre of study of these insects, of which many types are there preserved. The University awarded him an honorary M.A. in 1935. It is, perhaps, not widely known that in 1899 he conducted an expedition up Mt. Kina Balu in Borneo, though circumstances prevented him from reaching the summit: this resulted in the discovery of new species of reptiles, Amphibia, a new genus of fresh-water fish, many new insects and a new crustacean. G. D. HALE CARPENTER.

Prof. N. T. M. Wilsmore

IT is with great regret that his many friends in Great Britain have learned of the death in June of this year of Prof. N. T. M. Wilsmore.

Prof. Wilsmore was a graduate in chemistry of the University of Melbourne. Although he began his career as a student of engineering, he had to give up engineering science owing to short-sightedness. As a young man, Wilsmore went to University College, London, and worked in the laboratory of Sir William Ramsay, where he carried out many interesting and important researches, amongst which may be mentioned the discovery of ketene. After working some time in London, he went for a considerable period to Germany, where he gained an international reputation for his valuable work—in connexion especially with the determination of normal electrode potentials. Returning to University College about 1904, he became assistant professor of chemistry and greatly developed teaching and research in physical chemistry in the laboratory of Sir William Ramsay.

In 1913 Prof. Wilsmore was appointed professor of chemistry in the University of Western Australia at Perth. Here he built up an important school of chemistry, although he had to contend for many years with very inefficient laboratory accommodation. During the War of 1914–18, he did important war work in Australia and also came to London, where his services in the Department of Explosives Supply under Lord Moulton and Mr. Quinan were extremely valuable.

It may well be said that in Australia Wilsmore, like D. Steele, carried on the great tradition of Sir Orme Masson, and contributed very much to the development of chemical teaching and research in his native country. Wilsmore was specially interested in physical chemistry, and was indeed one of the principal exponents of that science as it was developed by the famous schools of Arrhenius, van't Hoff, Ostwald and Nernst. He was a man of extremely modest and retiring disposition, of great experimental ability combined with vast and accurate scholarship, and much beloved by all his students and colleagues. Towards the end of his life he acted for a while as deputy vice-chancellor of the University at Perth. Owing to the age limit, he retired in 1937. F. G. DONNAN.

WE regret to announce the following deaths:

Prof. E. W. W. Carlier, emeritus professor of physiology in the University of Birmingham, on September 2, aged seventy-eight.

Mr. E. M. Kindle, formerly chief palæontologist of the Dominion Geological Survey (Canada), on August 29, aged seventy-two.

NEWS AND VIEWS

Maintenance of Morale in War-time

Dr. Edward Glover has produced, as a "Penguin Special" entitled "The Psychology of Fear and Courage" (Harmondsworth and London: Penguin Books, Ltd. 6*d*. net), an apposite little book, which though giving evidence of a wide and deep knowledge of its subject, is written in a clear and popular style; in the main it consists of expansions of broadcasting addresses given by the author. It is concerned with morale, military and civilian, but chiefly civilian, in war-time; and it accordingly makes a searching analysis of the causes which may undermine this essential kind of courage. The technique of the enemy throughout his various *Blitzkrieg* campaigns has primarily been aimed at the destruction of morale by dividing against each other the citizens of the countries he intended to violate, by spreading alarming rumours, by disseminating lying propaganda and by playing upon the most vulnerable passions of his prospective victims—suspicion, fear, hatred, and the sense of guilt. Having thus attempted, with what success one knows, to subjugate their minds, he thereafter attacked them, civilians and military alike, by force of arms, overrunning their territories, destroying their cities, and murdering those who had had the temerity to withstand him. These brutally victorious campaigns are fresh in our minds; and we are now ourselves in the forefront of the battle. Our individual morale must not be shaken nor fail us; and those who are apt to be fearful can hearten themselves and strengthen their fortitude by a realization of the nature of the deep-lying causes of fear.

For the time being, the printing and publication of Nature may be delayed. Readers may be assured, however, that such delay, if any, will be kept to the minimum.

The very sensible and simple advice Dr. Glover gives is the outcome of a profound knowledge of psychology as well as of a wide practical acquaintance with morbid emotional states with which he has met in his dealings with individual patients as a consultant psychotherapist. This theoretical knowledge and practical acquaintance can be applied towards the production (if necessary) and maintenance of morale. It was long ago written that "Every kingdom divided against itself is brought to desolation; and every city or house divided against itself shall not stand" (*St. Matthew*, xii, 25). The enemy has taken this to heart and tried to implement it by lies, boasts and threats. But dissensions within nations are paralleled by dissensions, or technically 'conflicts', within individuals, of which they are usually quite unconscious; and these, established for the most part in early childhood, are what Dr. Glover lays bare. They are the causes of fear and loss of morale. To understand and to realize this is to exorcise, and in all likelihood to cast out, the obsession of fear and replace it by courage. This little book would be of interest at any time; it is vitally interesting now. It deserves the widest possible circulation.

U.S. Register of Scientific Workers

It is announced by Science Service, of Washington, D.C., that a National Roster of Scientific and Specialized Personnel in the United States is being compiled on lines similar to those used in Great Britain for the scientific research section of the Central Register of the Ministry of Labour. This index is being made jointly by the National Resources Planning Board and the U.S. Civil Service Commission, and is under the direction of Dr. Leonard Carmichael, president of Tufts College; James C. O'Brien, of the Civil Service Commission, is executive officer. National non-government organizations co-operating in the early stages of the scheme included the National Research Council, American Council on Education, American Council of Learned Societies, and the Social Science Research Council. As in Great Britain, the membership lists of learned societies will be largely used to get into touch with those having special qualifications; engineers will be included, but only the more specialized medical men, for a register of the latter has been compiled by the American Medical Association. Committees of specialists widely acquainted with various fields of learning will assist in classifying the index, and will also be charged with protecting the present educational and research endeavours which are carrying out important public services.

"The aim of the National Roster is the development of a means for the efficient and rapid but appropriate use of the specialized brains of America in the service of the nation," Dr. Carmichael explained. "Once started and organized, the value of the Roster to many constructive activities of peace-time, especially in connexion with modern personnel and employment services, will become obvious. With the passing of the present emergency, this Roster should not be abandoned, but rather, maintained as a continuing and always up-to-date census of the specialized brains of America. Even in a complete and continuing form, the development and maintenance of such a register will not be expensive in comparison with some of the other projects already undertaken for the preservation and effective use of our natural resources. The procedures which will be based upon the use of the Roster are at once effective and truly democratic. The time has come when our nation must be efficient. The National Roster of Scientific and Specialized Personnel is certainly a necessary tool of an effective democracy."

University Course for Officer Cadets

IN order to provide a steady flow of young men with the necessary mathematical and scientific knowledge into the Officer Cadet Training Units, the War Office has arranged for 1,200 men to be trained at selected universities every six months. By this means it is hoped to meet particularly the demands of the more technical branches, such as the Royal Engineers, Royal Corps of Signals and Royal Artillery. The men will be selected at examinations conducted in June and November by the Civil Service Commissioners, after which they will serve in a training unit for three months before proceeding to the selected university. The Government is to make a grant to the universities concerned to cover the cost of these courses. The age limits for those wishing to take the examination in November are 18–18½ by the end of this year; those taking it in June 1941 must be within the limiting ages on July 1, 1941. The first courses, to begin in October next, will be filled by candidates who were between the requisite age limits on June 1, 1940, and nominated by head masters or commanding officers.

Rumania's Cultural Losses

AMONG the consequences of Rumania's loss of territory (Bessarabia and Bukovina to Russia, the Dobrudja to Bulgaria and part of Transylvania to Hungary) are the cultural changes taking place within the ceded lands. The universities of Cernauti (Czernowitz) and Chishinau (Kishenev) and the Observatory at Dubosarii Vechi have been transferred to the Soviet Union. In the Dobrudja there is no institution of university rank, but there are important local high schools. The greatest cultural losses are in Transylvania, where there are many important educational institutions, including the Universities of Kluj (Klausenburg) and Oradea Mare (Grosswardein) and the headquarters and branches of several learned societies. At Kluj, the capital of Transylvania, the University had famous medical and science faculties, and its library was the largest provincial one in the country. Two celebrated museums are lost, namely, the Transylvanian Ethnographical Museum and another with general and local natural history collections.

It is in this part of Rumania that the largest German minority is mainly settled and centres of German culture now pass back to Hungary, though the town of Sibiu (Hermannstadt) with its Brukenthal Museum and German library remain in Rumania. A number of Rumanian men of science and learning have had to relinquish their posts and have been transferred to Bucharest and other places in diminished Rumania. Their colleagues and fellow scientific workers in other lands extend their sympathy, trusting that their work for mankind may soon be resumed in happier circumstances.

Britain's Supplies of Feeding-stuffs

IN view of the actual and prospective shortage of feeding-stuffs in Britain, attention may be directed to the comprehensive study of the situation made by Dr. Norman C. Wright, director of the Hannah Dairy Research Institute, in the *Empire Journal of Experimental Agriculture* for July 1940 (see also NATURE of August 24, p. 251). In this study, which gives detailed trade statistics for the period 1934–8, the author stresses the great part played by our grasslands in providing food for livestock; grazing and hay together supply just under 60 per cent of the protein and starch equivalents consumed. Together with the products of arable land, our home supplies constitute about three quarters of the total available. Unfortunately, however, grass, including hay, is essentially a seasonal product, and the question of supplies in winter during war-time becomes very serious, especially in respect of pigs and poultry, which are mainly fed on cereals and concentrates, and of which we import 70–75 per cent of our requirements. Owing to shortage of shipping and to currency restrictions, supplies of all imported feeding-stuffs will be much reduced next winter, and it seems likely that the pre-War proportions of cereal and oil-seed imports will remain unaltered.

The choice of imports and of crops to be grown for home production should be governed primarily by accessibility of overseas producing areas, by suitability for storage, and by the practicability of diversion to human consumption. The ploughing-up policy, which has already added 2,034,000 acres to our arable land, will eventually increase the supplies of nutrients available for winter feeding, and when the ploughed-up land reverts to pasture there will be a marked increase in productivity. Maximum economy in the use of feeding-stuffs demands a definite order of priority in the allocation of supplies to different classes of livestock. Cereals are the most economical supplies of energy to the human population, and in war-time animal products should be regarded essentially as sources of the 'protective' foods, namely, first-class protein, minerals and vitamins. Milk and milk products are of outstanding value in this respect: eggs are of special value in cooking and for invalid dietaries; meat is of secondary importance; bacon and butter are valuable, but not essential, sources of fat. Everything points to the importance of maintaining our dairy herds and of increasing our imports of cheese, eggs, and bacon from Empire countries, though at present these are exporting practically up to the hilt.

After satisfying the requirements of milch cows, Dr. Norman Wright thinks that feeding-stuffs should be preferentially allocated to poultry and pigs, and not, as has been officially intimated, to beef cattle and sheep, for these provide less valuable animal products at greater feed-cost and can be largely maintained on grass and coarse fodders. The official preference for beef cattle and sheep is due to their greater indirect effect on soil fertility and to the fact that they take far longer to reproduce than pigs and poultry, but much expert opinion is in favour of Dr. Norman Wright's view.

Sir William Chambers

The July issue of the *Anglo-Swedish Review* contains an interesting editorial on the life and work of the architect Sir William Chambers, who was born at Gothenburg in 1723, and died in 1796 in London, when he was buried in Westminster Abbey. In 1739 he entered the service of the Swedish East India Company, and the next year sailed to China as a cadet, and in 1743–45 as an assistant. During his stay in China he devoted himself to the study of Chinese architecture, which exercised a considerable influence on his future. The importance of Chambers is due to the fact that he was the first to furnish accurate information on Chinese architectural interior decoration and garden planning based on personal observations in the East. He made his reputation by the grounds which he designed at Kew, including the pagoda in the gardens, between 1757 and 1762. In 1775 he was appointed the architect to Somerset House. He also designed mansions for Earl Gower at Whitehall and Lord Melbourne in Piccadilly. His principal publications were "Designs of Chinese Buildings, Furniture, Dresses, Machines and Utensils" (1757) and "Plans, Elevations, Sections and Perspective Views of the Gardens and Building at Kew in Surrey" (1763).

Biology in Australian Schools

At the first public meeting of the Victorian branch of the newly formed Association of Scientific Workers (Australia) held on March 19 in the University of Melbourne, the place of biology in school education was discussed. Prof. J. S. Turner pointed out the inadequacy of the present teaching of science in schools and said that the child is only educated for life if his school science includes an introduction to biology in addition to training in chemistry and physics. The solution of many problems of a troubled world requires biological knowledge—it is enough simply to enumerate them: education, hygiene, nutrition, quack remedies, racial prejudice, population drifts, immigration, agriculture, forestry, soil erosion. Going on to give some statistics regarding Victoria, he showed that inquiries at 36 large schools (including 4 of the largest public schools) revealed that 17 of these schools do not teach biology at any stage to their 6,300 pupils. At the other 19 schools there are 8,000 pupils, 2,500 of whom were of Intermediate or Leaving standing. Of these, 254 take biological science, 230 botany, 570 zoology. In Victoria there are 150 State Secondary, High and non-State Secondary schools, and in only 77 of these is any kind of biology taught. Of the 77 schools teaching biology only 5 or 6 are boys' schools or mixed schools, and it appears probable that in any one year only a hundred or two hundred boys in the whole of the State are introduced in a scientific study of animals, plants and man. Of the 3,500 boys and girls who in 1938 took English and arithmetic in public examinations, 2,050 took also British history; 400 (all girls) took botany, 500 (about 100 boys) took zoology and 72 took agricultural science.

Prof. S. M. Wadham discussed the lack of biological training in citizens in connexion with the various political systems; he pointed out that the successful introduction of biology in English schools during the last decade was in part due to the decision to allow medical students to pass their first M.B. examination while still at school. Biology is largely a cultural subject, and its introduction into schools would be opposed unless it could be shown to be of direct advantage in later life. Mr. Colman, Inspector of Schools in Victoria, agreed that an extension of biological teaching was desirable, but discussed the difficulties of school time-tables. He showed that attempts were being made to introduce courses of biological and physical sciences into the State schools. Miss Cunningham, of Fintona School, gave her opinion that time-table difficulties are by no means insuperable, and thinks that there can be no argument as to the cultural value of biology in schools. She has introduced a compulsory course dealing largely with human physiology and she found her pupils vitally interested. Prof. R. D. Wright said that the average person's abysmal ignorance of dietetics and normal functions is to be deplored. He is inclined to the view that biology, dealing with variable material, is of greater value as a school science than pure physics or chemistry.

Conserving Supplies of Potash Alkalis

With the object of ensuring that the reduced supplies of potash compounds shall be used to the best advantage the Ministry of Supply has made an Order under which purchases by consumers of caustic potash and carbonate of potash may be made only under licence. Licences will not be granted except in cases where substitution of potash by soda is impossible, but for the present, lots not exceeding half a ton a month are exempt from the Order. Compared with the vast quantities of potassium compounds used as fertilizers the amount used in the manufacture of medicinal salts is small; at a rough estimate it is probable that it does not exceed 5 per cent of the total consumption of potash; but it is desirable, nevertheless, that medical practitioners should prescribe sodium or ammonium compounds instead of potassium compounds whenever this substitution can be made without prejudice to patients. For example, sodium or ammonium bromide should be used instead of potassium bromide and sodium iodide in place of potassium iodide; and so the list might be extended. In the aggregate, the quantity of potash saved for potatoes and other market garden crops and sugar beet, for example, would not be inconsiderable.

Infectious Diseases and Aeroplanes

In a recent thesis (*Thèse de Paris*, No. 217; (1940), Dr. J. M. Chauvisé remarks that in addition to the precautions applicable to passengers on aeroplanes coming from countries in which malaria, yellow fever and dengue are present, special prophylactic measures are necessary for destruction on the aeroplanes of the insects carrying these diseases. This prophylaxis should be carried out both on departure by a rigorous supervision of the openings in the machines and on arrival by a careful examination of the machine and a search for the hiding places of dangerous insects. The method at present employed consists in the use of a spray with various kinds of pyrethrum, though flies, ticks, bugs and other sorts of insects are not destroyed by it. Disinfestation of the machine during flight should be carried out by an apparatus containing a mixture of pyrethrum and carbon tetrachloride possessing the following characters: (1) it should be rigorously non-inflammable; (2) it should have no injurious action on metals or materials; and (3) it should not irritate the passengers' mucous membranes. Inspection of the aerodrome should include a search on the aeroplanes for the internal and external hiding places of mosquitoes into which ordinary disinfestants cannot enter without direct spraying. There is a general tendency to neglect entirely the outside of the aeroplanes, although it contains numerous possible places of concealment for mosquitoes.

Food of Fur Animals in Captivity

PRACTICALLY the only animals that are now being bred commercially for their fur are silver-foxes, minks and rabbits. Others have been tried, but costs of feeding, overhead charges generally, and difficulties of inducing breeding in captivity made the price of the skins greater than that of equally good wild-caught examples, so that the undertakings came to an end. To some extent, the first needs in this relatively new industry were the testing of equipment, the perfection of methods of management, and the control of diseases and parasitic infestations. These problems have been tackled, but until recently no attempt had been made to discover by controlled experimental work the diets most suitable as regards results and costs for the carnivorous animals recently taken from the wild. The Yearbook of Agriculture for 1939 of the U.S. Department of Agriculture contained an article by Charles E. Kellogg on "Nutrition of Fur Animals", which has been reprinted as Yearbook Separate No. 1717 (U.S. Govt. Printing Office, 1940). It contains in 22 pages a summary of the scientific work carried out at the four or five experimental stations in the United States where nutritional research with fur animals has been carried out. It is impossible to indicate the findings here; but they should be of value to breeders of fur animals in this country, whenever circumstances permit again the development of the fur-farming industry.

A Flooded Power Station

ON August 20, 1939, a flood occurred at Tientsin in China which is stated to have been of unprecedented dimensions even for that part of the Far East, where floods are not infrequent. Mr. F. A. Matthews, chief engineer of the Electricity Department, British Municipal Council, Tientsin, tells a graphic story of this terrible flood, according to the *Electrical Times* of August 8. Despite elaborate precautions, within a few hours the water forced its way into the station basements of the hydro-electric plant until the depth of the water was 6 ft. 6 in., and the power station was crippled for five weeks. The dyking of the power station compound and entrance was commenced immediately and in about four weeks it was possible to hold the flood waters at a safe level by pumps. Reconditioning of the flooded auxiliaries followed, and on September 24 the department was able to take over the load of the area from the Belgian Tramways Co., which had been giving a temporary supply.

The two large Metro-Vick turbo sets, each of 2,500 kw. capacity, had perforce to stop during the floods, and the opportunity was taken to recondition them. Alterations and improvements were also made in the boiler plant, giving marked betterment in coal consumption and heat recovery. Earlier in the year, restrictions and blockade had had an adverse effect on load conditions generally and many factories had to shut down. Members of the Electricity Department staff living outside the concession found it extremely difficult to get to and from their homes, and they had therefore to be housed within the Concession's boundary. In the latter part of the year, load conditions improved, and records were made by both income and profits.

July Earthquakes

THE U.S. Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has made a preliminary determination of the epicentres of five earthquakes which occurred during the early part of July 1940. The first on July 6 had an epicentre in the sea to the north of Toco in Trinidad, and a fairly deep focus, probably of the order of 175 km. The second on July 10 took place to the north-east of Kirin in Manchukuo. This may have been a very deep focus earthquake with a depth of focus in the neighbourhood of 450 km. The third on July 13 was in the Pacific Ocean to the south of P. Burica in Central America. The fourth on July 14 had an epicentre near Rat Island in the Aleutian Islands group, and the fifth on July 19 had its epicentre in the sea bed to the north of Attu also in the Aleutian Islands group. The above determinations, based on reports from twenty-two seismographic stations, indicate the continuation of recent activity in the Aleutian Islands, and off the Pacific coast of Central America. The shock near Trinidad is a continuation of previous activity and the deep focus earthquake near Kirin extends to the north-west the previously known Japanese deep-focus portion of the circum-Pacific belt.

Indian Statistical Conference

THE second session of this Conference was held in Lahore in January 1939; the Proceedings were published in March 1940 and were received here in August (Edited by P. C. Mahalanobis. Pp. ii+168. Calcutta:

Statistical Publishing Society, 1940.) As in the first session a year before, there were sections dealing with theoretical statistics, agricultural statistics, and economic statistics, but an anthropological section has been added. The medical and public health section has disappeared, which is rather surprising, in view of the recent creation of the new post of medical statistician to the Government of India and a separate post for vital statistics at the All-India Institute of Hygiene and Public Health. The annual review by the general secretary, Prof. P. C. Mahalanobis, recalled the long association of the Punjab with statistical work. The study of the connexion between snowfall in the Punjab hills and the monsoon in North India formed the basis of Sir Gilbert Walker's work on weather correlations and his statistical method for long-range forecasting of the monsoon. This led to the concept of world weather; for example, the monsoon in India is controlled by weather conditions six months earlier in Java, Africa, or South America. It was also in the Punjab that pioneer work was done by Mr. Jacob on the influence of rainfall on the yield of wheat. Statistics has played an important part in the Punjab irrigation projects. In the year under review, extensive researches have been carried out in the field and laboratory for the improvement of the jute forecast, a problem of the greatest economic importance for India. The Statistical Institute has actively helped the Government of Bengal in an elaborate crop-cutting experiment for estimating the out-turn of rice. A report has been prepared on certain anti-mosquito experiments undertaken by the Bengal Public Health Department for the control of malaria. A diet survey on a random sample basis has been started in Calcutta. Work has also been carried out on various topics in theoretical statistics.

Education in India

THE "Progress of Education in India, 1932–1937" by John Sargent (Government of India Press, Simla, 5*s.*) is a paper book of 285 pages, well supplied with statistics and diagrams. The report deals with the period before Mr. Sargent became educational commissioner, and we share his feeling that the years which elapse while publication is delayed should be reduced to a minimum. The material is, indeed, vast, but surely the reports of various provinces can be secured and summarized within a year of their receipt. The period has been one of special difficulty, due to financial stress, which did not justify the optimism of the previous report. Several provinces speak strongly about the cramping of education, but retrenchment introduced on economic grounds is being gradually relaxed. Depression has produced a consensus of opinion that the present system is not practical enough in view of the needs of later life—a point in which the United States takes the lead. Secondary education in India needs particular attention.

The Central Advisory Board of Education, abolished in 1923, was revived in 1935 and has received the comments of two experts from England. It was found to be needed when control was handed over to the provinces, and there is enough evidence of that in this report. The Bureau of Education at headquarters was also abolished and revived. The decrease in the number of schools is largely to be attributed to wise measures of consolidation. We note, however, that in five provinces privately managed schools made the cost per pupil lower than in others. But in the whole of British India "the percentage of pupils attending all types of schools to the total population is 5–2 only". This is clearly not enough. Local autonomy has its defects as well as its advantages. Action is taken on grounds other than educational. Party strife and personal reasons have intervened, and the power that membership of a committee gives is noted as used unsatisfactorily in the Central Provinces. Inspectors are not pleased. This is a deep-rooted evil, and it will take some time to create a proper and general sense of responsibility among Indian managers of education.

Announcements

BY an Order of the Committee of Privy Council, the Right Hon. James Gray Stuart, M.P., has been appointed a member of the Medical Research Council in the vacancy caused by the resignation of Mr. R. K. Law, M.P. By another Order, made after consultation with the Medical Research Council and with the President of the Royal Society, Sir W. Wilson Jameson, dean of the London School of Hygiene and Tropical Medicine, has been appointed to be a member of the Council in succession to Prof. Matthew J. Stewart, who retires in rotation on September 30.

IT is announced in *Science* that Prof. Carl Neuberg, formerly professor in the University of Berlin, for twelve years director of the Kaiser Wilhelm Institute for Biochemistry until his retirement with the title emeritus in 1937, has been appointed research professor of chemistry in the Washington Square College of Arts and Sciences of New York University. He will take up the work in September, following his arrival in the United States from Palestine, where he has been teaching at the University of Jerusalem.

THE Borden award of a medal and a thousand dollars for research in nutrition was recently made to Dr. Henry C. Sherman, Mitchill professor of chemistry, Columbia University, New York, for his researches on enzymes, vitamins and the mineral elements in nutrition.

MESSRS. W. AND J. GEORGE LTD., proprietors of F. E. Becker and Co., have recently issued a new 96-page price list of laboratory chemicals, analytical reagents, stains and solutions. A feature which will commend itself at once is the setting out in the body of the list of the maximum limits of impurity to which the analytical reagents conform; and each bottle of 'Nivoc Analytical Reagent' now bears a guarantee to this effect.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Night-Shining Eyes

SPELÆOLOGISTS have perhaps rather exceptional opportunities for observing 'night-shining' in human eyes. I have seen it on three occasions with different individuals, and once was accused of exhibiting the phenomenon myself.

On all occasions the observer was below the object and the illuminant was the concentrated beam of a focused electric torch. The glow from the eyes is a most uncanny tawny orange, causing exclamations of horror.

Once only have I seen night-shining by a human outside a cave. An Indian woman, who was bending low down, looked back from that position at the headlights of my car—a momentary gleam from her eyes, which ceased as she stood up and faced the light. Hence the incidence of the light on the eyes on this occasion was similar to that on the previous occasions in caves. Is it possible that the normal individual only exhibits the phenomenon when, with dilated pupils, he is caught by a concentrated beam of light coming from this rather unusual direction ?

E. A. GLENNIE,
Regional Recorder (India),
British Spelæological Association.

Dehra Dun,
United Provinces,
India.

THE explanation of "night-shining eyes" is well known. The retina and choroid act as a mirror. In the emmetropic eye the light reflected from the fundus emerges in a parallel beam ; hence none of it can enter an observer's eye unless this is placed in the comparatively narrow beam of light—the principle of the ophthalmoscope. In highly hypermetropic eyes the emergent beams are widely divergent, and therefore an observer's eye can see a reflex from the pupil over a considerable area. Glioma of the retina in a baby is usually discovered by the mother noticing a yellow reflex from the pupil, as the so-called "amaurotic cat's eye".

The eyes of most lower mammals are usually highly hypermetropic, and many of them are provided with a special reflecting membrane, absent in man, the tapetum. This occurs in two forms, a fibrous and a cellular, sometimes provided with crystals. The tapetum causes iridescence in the reflected light—hence the variety of colours investigated by Mr. E. D. Walker (see NATURE, March 30, p. 506).

The rareness of the observation of "night-shining" in human eyes is due to the facts that the observed eye must be highly hypermetropic (or still more rarely very highly myopic), the incident light must be bright, and the observing eye must be so placed that some of the reflected rays enter it.

J. HERBERT PARSONS.

Influence of Temperature on Osmotic Behaviour of Some Crustacea and its Bearing on Problems of Animal Distribution

A SEASONAL cycle in the osmotic concentration of the blood of some amphipods, isopods and decapods has been reported by Widmann[1] and Otto[2]. Both these authors observed a higher value for blood in winter than in summer; the animals examined included marine, freshwater and air-breathing species. In Eriocheir, Otto[2] was able to correlate these changes directly with the temperature of the external medium. Krogh[3], reviewing the subject, mentions that the ecological significance of these facts is unknown.

Working on the osmo-regulation of Palæmonid prawns, I find that *Leander serratus* and *Palæmonetes varians* show a similar behaviour in having slightly higher osmotic values in winter than in summer. Both these prawns normally maintain their blood concentrations at a steady state hypotonic to the environment when in sea water[4,5]. During summer, the mean values for osmotic pressure of blood of the two prawns were about 2·3 and 2·6 per cent NaCl respectively ; the corresponding values for last winter were 2·4 and 2·8 per cent NaCl. These differences are not insignificant when it is remembered that both these prawns are more or less homoiosmotic, and especially *P. varians*, which shows only a difference of about 0·5 per cent NaCl in internal-osmotic pressure for a change in environment of 3·5 per cent NaCl. It may also be mentioned that neither of the species shows any appreciable osmotic change in response to changes in salinity of sea water between 3·3 and 3·5 per cent NaCl, the normal limits of variation of Plymouth tank water.

Experiments under temperature control which are in progress show that the above-mentioned seasonal variation is independent of other factors like starvation and moulting. When prawns are transferred directly from normal to dilute sea water the mortality is higher in winter than when the temperature is high. The data so far obtained also indicate a *lower* dilution curve for blood of animals kept at a *higher* temperature, in substantial agreement with the observations of Otto[2] who found that Eriocheir transferred from sea water to tap water showed after four days an osmotic pressure of Δ1·355° C. (2·32 per cent NaCl) at 13° C., but only Δ1·27° C. (2·18 per cent NaCl) at 23° C. These results show that (*a*) the optimum osmotic pressure of homoiosmotic species falls with rise in temperature of the medium ; (*b*) in diluted media the minimum osmotic pressure of blood compatible with life is lower the higher the temperature, and hence the osmotic work required in maintaining hypertonicity is less at higher temperatures. It follows, therefore, that in euryhaline species where the mechanism of maintaining hypertonicity is well developed, the range of tolerance to dilution of the environment is greater at higher temperatures and that a marine species which may only have feeble powers of regulation can penetrate into brackish water far more easily at higher than at lower temperatures.

These facts appear to be highly significant in the light of certain problems in animal distribution. It is well known that *Palæmonetes varians* which lives in brackish-water in northern Europe inhabits fresh-water in the coasts of the Mediterranean and that closely related fresh-water species exist in North Africa and other tropical regions. There are many other instances of true salt-water species of northern latitudes being represented in fresh-water by similar or identical species farther south in warmer regions. In all these cases, it would appear that the influence of temperature on osmotic behaviour in enabling a species to have a wider limit of tolerance to dilution of the environment is a probable physiological explanation of this peculiarity in distribution. Ecological observations on some other Crustacea have shown an inverse correlation between temperature and salinity[6,7,8].

The active colonization of fresh and brackish waters by marine animals is a characteristic feature of tropical coasts and it has often been explained by the familiar hypothesis of Von Martens[9] of the relative evenness of temperature of tropical waters, and the high rainfall and the presence of large rivers opening into the sea which profoundly alter the coastal salinities. Of all these factors, temperature is probably the most important since in the tropics the difference between the air, sea- and fresh-water temperatures is relatively small in addition to the fact that tropical fresh-waters are not liable to freezing. It is usual to find specialized brackish-water faunas even in places where the coastal salinity is not appreciably altered either by heavy rainfall or by large rivers[10]. The fact that high temperature reduces the optimum osmotic pressure of animals in diluted media and increases their range of tolerance to lower salinities would seem to be a physiological reason for adaptation to brackish and fresh water taking place more actively in warm seas than in cold.

N. Kesava Panikkar.

Marine Biological Laboratory,
Plymouth.
August 22.

[1] Widmann, E., *Z. wiss. Zool.*, **147**, 132–169 (1935).

[2] Otto, J. P., *Zool. Anz.*, **119**, 98–105 (1937).

[3] Krogh, A., "Osmotic Regulation in Aquatic Animals" (1939).

[4] Panikkar, N. K., Nature, **144**, 866 (1939).

[5] Panikkar, N. K., Nature, **145**, 108 (1940).

[6] Schmankewitsch, W., *Z. wiss. Zool.*, **29**, 429–94 (1877).

[7] Broekhuysen, G. J., *Arch. Neerl. Zool.*, **2**, 257–400 (1936).

[8] Caudri, L. W. D., *Arch. Neerl. Zool.*, **3**, 179–196 (1937).

[9] Von Martens, E., *Ann. Mag. Nat. Hist.* (3), **1**, 50 (1858).

[10] Panikkar, N. K., and Aiyar, R. G., *Proc. Indian Acad. Sci.*, B, **6**, 284–337 (1937).

Relative Kidney Weights of Male and Female Mice

In a recent publication[1] it is reported that treatment with androgens produces great hypertrophy in the kidneys of male mice. Testosterone propionate alone increased the relative kidney weight (average kidney weight in mgm. per gm. body weight) by 35 per cent in comparison with untreated mice, while simultaneous administration of œstrogen produced an increase up to 80 per cent. These authors do not say whether they have ascertained if any difference between the two sexes in kidney weight is found in normal mice.

In this Institute, data upon this matter were obtained in the course of an investigation of possible pre-cancerous factors in several pure lines of mice. The average relative kidney weight for 16 male mice of the C_3H strain, age 35–195 days, was 14·1 mgm. per gm. The corresponding value for 16 female mice of the same strain, age 35–244 days, was 12·6 mgm. per gm. The extremes in the two groups were 11·7–16·7 mgm. and 11·2–15·3 mgm. respectively. The difference between the two average values (1·5 mgm.) is significant ($t = 3{\cdot}1$). Differences of the same order were found in mice of the Dilute Brown and of the *CBA* strain (4 mice of each sex in both strains). When the data for mice of these strains (48 mice in all) are pooled, the average relative kidney weight obtained is 15·2 mgm. (male) and 12·9 mgm. (female).

No significant difference between the relative liver weights of the two sexes was observed.

This sexual difference in the kidney weights may be related to the microscopical observation of Crabtree[2], who found hypertrophy of the parietal layer of Bowman's capsule in 89 per cent of adult male mice and in only 13 per cent of adult females.

Afterwards some corresponding data for untreated rats were found in the literature[3], which indicate that the average relative kidney weight of the male exceeds that of the female.

F. L. Warren.

The Chester Beatty Research Institute,
The Royal Cancer Hospital (Free),
London, S.W.3.
August 24.

[1] Pfeiffer, C. A., Emmel, V. M., and Gardner, W. U., *Yale J. Biol. and Med.*, **12**, 493 (1940).

[2] Crabtree, C., *Science*, **91**, 299 (1940).

[3] Walter, F., and Addis, T., *J. Exp. Med.*, **69**, 467 (1939).

A Prolific Trematode

The asexual generation of the trematode *Cryptocotyle lingua* Creplin is passed in the winkle, *Littorina littorea* L. A miracidium, hatching from a single egg of which many thousands are laid, gives rise to rediæ which feed upon the tissues of the host, and in their turn liberate free swimming cercariæ. In 1935, we collected a large winkle infected with this parasite, and kept it in a finger-bowl of sea-water for five years. During the first week in captivity the winkle, living on a diet of Ulva, emitted an average of 3,300 cercariæ a day, reaching a grand total of approximately 1,300,000 in the first year. Cercariæ have emerged constantly ever since, although there has been a gradual decrease in numbers, so that during August 1940 the mean has fallen to a mere 830 per day. Although at the time of capture the winkle was the largest specimen among hundreds collected, and despite the drain on its constitution, it has since increased its shell size by 3½ mm.

When it is considered that in some localities the percentage of gastropods infected with trematode parasites is high (reaching 40 per cent in the case of *Hydrobia ulvae* Pennant at Plymouth) some idea can be gained of the astronomical numbers of these free-swimming larvæ. They form part of that section of the marine fauna which, although known to be present, inevitably escapes record in samples of the plankton.

ELIZABETH MEYERHOF.
MIRIAM ROTHSCHILD.

Aston Wold,
Peterborough.
August 19.

A Possible Case of Polyploidy in a Prosobranch Mollusc

IN his recent useful summary in NATURE of July 27, on evidence for polyploidy in hermaphrodite groups of animals, Dr. M. J. D. White remarks that in the pulmonate molluscs (*Helix pomatia* possibly excepted) there is no evidence of polyploidy. Dr. White will therefore be interested in a possible case in another group of molluscs. The species concerned is the parthenogenetic *Potamopyrgus jenkinsi* Smith, of brackish waters. The British form has been studied by my assistant, Dr. Ann R. Sanderson, and in her absence from home (she has been in Australia for some time) her findings were reported for her at the Dundee meeting of the British Association in 1939[1]. Her more detailed paper[2] has been in the press for some time, but war conditions have delayed publication.

Briefly, the British form of *P. jenkinsi* has a diploid chromosome number of between 36 and 44 but Rhein, in a preliminary note[3] without figures or details, stated previously that a Continental form had a diploid constitution of 20–22. The species is very difficult to study cytologically, but Dr. Sanderson's careful studies allow no other interpretation regarding the chromosome constitution of the British form, so that, unless Rhein has misinterpreted his preparations, the possibility exists that the British form is polyploid, and presumably tetraploid, by comparison with Rhein's Continental form.

Comparisons with British forms of related species and with an Australian form of *P. jenkinsi* are being made by Dr. Sanderson, but all that may be reported at the moment is that the diœcious British form of *Peringia ulvæ* (Pennant) shows a diploid count of 36. It may also be mentioned that the only other known parthenogenetic snail, the American *Campeloma rufum* Haldeman, recently studied by Mattox[4], has a diploid count of 12.

A. D. PEACOCK.

University College,
University of St. Andrews,
Dundee.

---

[1] Sanderson, "British Association, Journal of Sectional Transactions" p. 90 (1939).

[2] Sanderson, *Proc. Zool. Soc.*, A (in the press, 1940).

[3] Rhein, *Naturwiss.*, 6 (1935).

[4] Mattox, *Z. Zellforsch.*, 27 (1937).

A Species of Mosquito (Diptera, Culicidæ) New to Britain

On August 20, when examining a batch of larvæ collected that morning at Portsmouth, I found a third instar larva of the culicine mosquito *Theobaldia* (*Allotheobaldia*) *longiareolata* Macquart, a species which has not hitherto been recorded in Great Britain. A further search next day yielded four more third and two fourth instar larvæ.

Other species collected in association with them were *Anopheles claviger*, pupa *Aedes detritus*, *Theobaldia annulata*, *Tsubochrea*, and *Culex pipiens* larvæ and pupæ, of which the Aedes was the dominant species.

The batch of larvæ and pupæ in question were collected from a small pool of rather foul, slightly saline, water at the northern, inner, silted up end of a moat and where a mixed collection of rubbish had been discharged. There was a strong growth of *Spartina Townsendi* on the southern margin.

Dr. Edwards states that *T. longiareolata* is distributed "throughout the Mediterranean and in most of the Atlantic Islands. . . . In France it has been taken as far north as Rambouillet (Villeneuve) but it appears to be unknown in central and northern Europe".

JOHN STALEY.

British Mosquito Control Institute,
Hayling Island,
Hampshire.
August 26.

Blind Seed Disease of Rye-Grass

THE recent communication by Muskett and Calvert[1] concerning the presence of blind seed disease of rye-grass prompts me to put on record the following observations so far made at Wye, Kent, with material collected in east Kent.

In the winter of 1939 a total of twenty-seven samples of rye-grass seed was submitted to me by a firm of seedsmen with a request that they be examined for a disease thought to be caused by Pullularia species. Most of the samples were from old pastures and some from more recently sown Kent indigenous rye-grass ('once-grown'). Tests made by the firm had shown that germination was low for all samples except two which had been specially grown from strains produced at the Welsh Plant Breeding Station, Aberystwyth.

The individual samples were examined on a diaphanoscope and the least translucent and the opaque seeds were selected for dissection. It was found that no less than twenty-five of the samples provided seeds which bore on the caryopsis conidia agreeing with those described by Neill and Hyde[2] as being produced by the blind seed fungus. Cultures made from surface-sterilized caryopses, together with some of the selected seeds, were submitted to Neill at Auckland, New Zealand, who expressed the opinion that the cultures were apparently identical with those obtained in New Zealand from 'blind seeds' of rye-grass and that the seeds themselves were also typical. The presence of the blind seed fungus within the caryopses of rye-grass seed from these samples of low germination strongly suggests that the disease is widespread in the fields of east Kent.

Following the method carried out by Neill and Hyde[2], fifty seeds from each of three of the above twenty-five infected samples were sown in separate pots of sterilized soil and placed in an unheated glasshouse. The sowing was carried out on February 21 and regular observations were made. A number of the seeds from each sample germinated and produced plants. By June 11, a time when the first spikes were flowering, one of the 'blind seeds' from a pot in the glasshouse had produced an apothecium which agreed with the description by Neill and Hyde of the apothecia similarly produced in New Zealand. On July 23, another seed in the same pot produced two apothecia similarly agreeing and exactly like those illustrated by Muskett and Calvert.

The above facts, together with those given by Muskett and Calvert, show that the blind seed disease is present in Northern Ireland and in England and both the conidial and apothecial stages have been produced. They also confirm the observations of Neill and Hyde, who found the disease in rye-grass seeds grown in England and Ireland.

H. H. GLASSCOCK.

Mycology Department,
South-Eastern Agricultural College,
Wye, Kent.
August 16.

---

[1] Muskett, A. E., and Calvert, E. L., NATURE, **146**, 200 (1940).

[2] Neill, J. C., and Hyde, E. O. C., *New Zealand J. Sci. Tech.*, **20**, 281A (1939).

Production of Randomness as a Suggested Measure of Intelligence

It is well known[1] that attempts to guess numbers at random are usually highly unsuccessful, a fact which suggests the possibility of measuring intelligence by the degree of randomness produced. If asked to produce random numbers from say 0 to 9 inclusive, an intelligent person will at once recognize, and therefore tend to avoid, 'runs' of the type 4567, 9862, etc., and it may be supposed that the failure to recognize a relationship between a number now being spoken and one given a second or so previously will be negatively correlated with intelligence.

That this is indeed the case was strongly suggested by trial, agreement between expectation and subjective estimates of intelligence being often observed. In addition, Dr. G. van Praag of Christ's Hospital, Horsham, has kindly provided eighteen such sets of one hundred numbers each, produced by nine boys specially selected on account of marked contrasts in intelligence, physique and character, together with the 'mental ratios' of the boys concerned. The numbers were examined by the method of 'runs'[2], the average lengths, L_1, L_2, of the 'runs' being worked out for the first and second hundred numbers respectively for each boy. Using the rank order method, the coefficient of correlation between mental ratio and L_1 was $+ 0{\cdot}77$ and for $L_2 + 0{\cdot}40$. The correlation between L_1 and L_2 was $+ 0{\cdot}63$.

While it is not claimed that these figures necessarily prove a correlation of the type suggested, the method is apparently worth investigating, especially as, if successful, it should be easy to construct a mechanical device by which the average lengths of 'runs' would be automatically recorded, thus greatly facilitating the measurement of intelligence. In view of lack of opportunity, I have no wish to reserve this field of research.

R. E. D. CLARK.

St. John's College,
Cambridge.
August 16.

---

[1] Tyrrell, *Proc. Soc. Psy. Res.*, **44**, 99 (1936).

[2] Kermack and McKendrick, *Proc. Roy. Soc. Edin.*, **57**, 228 (1937).

First Use of Current-Bedding to Determine Orientation of Strata

In a recent communication[1], A. Lamont has directed attention to the application of current-bedding to the determination of the orientation of strata made by John Kelly in 1864. This does not mean, however, that John Kelly was the first geologist to realize the importance of current-bedding, its mode of formation and its relation to the strata. The first, rather crude representation of current-bedding, which I was able to find, was published by MacCulloch in 1819[2] (vol. 3, pl. 18, Fig. 2). This figure refers to the well-known Scalpa Sandstone of Strathaird in Skye, but MacCulloch's description and explanation of this occurrence (vol. 1, p. 348) are rather inadequate. The first correct interpretation of current-bedding was given by Lyell, who in company with L. A. Necker in 1829 had examined a section at the confluence of Rhone and Arve[3]. Lyell has also described many examples of current-bedding found in strata of different ages, including the Pre-Cambrian[5]. He was perfectly aware that the truncated parts of the laminæ indicate the upper part of the strata.

S. I. TOMKEIEFF.

Geological Department,
King's College,
University of Durham,
Newcastle-on-Tyne.
August 14.

---

[1] NATURE, **145**, 1016 (1940).

[2] MacCulloch, J., "A Description of the Western Islands of Scotland, etc.", London (1819).

[3] Lyell, Ch., "Principles of Geology, etc.", London, vol. 1, p. 254, Fig. 6 (1830).

[4] *Ibid.*, vol. 1, p. 378, Fig. 13 (1837).

[5] *Ibid.*, vol. 4, pp. 78–81, 361–363 (1837).

Visible Sound Waves

I WITNESSED recently from a hill part of the air fighting which took place in a midday air-raid.

I was facing north, in which direction the fighting lay, the sun at its zenith being behind me. In front of me and at an elevation of about 70–80° and at a great height were a number of the exhaust trails from some of the British fighters, which stood out white against a blue sky. I suddenly noticed a number of dark bars equidistantly spaced running along the trails from a north-westerly direction, from which the sound of various explosions could be heard. As the battle moved north and then eastward, so the direction from which the ripples appeared to come altered, and different trains of waves appeared to have somewhat different wave-lengths.

It seems clear that these were the shadows of sound waves shown on the white background of the exhaust trails and caused by the sunlight being differently refracted through the condensations and rarefactions of the waves. The phenomenon was, in fact, analogous to what may be seen when looking through shallow sunlit water on to a sandy beach, where the shadow of the ripples is seen on the sand.

It is probable that many other people favourably placed may have witnessed this very large-scale demonstration of making sound waves visible, but may not have recorded it.

A. BLACKIE.

7 Vanbrugh Park,
Blackheath, S.E.3.
August 20.

RESEARCH ITEMS

Early Iron Age Burial, Bedfordshire

AN Early Iron Age site at Eggington, Bedfordshire, excavated in 1931 and described by Frederick G. Gurney (*Antiq. J.*, **20**, 2; 1940) has afforded from an exhumation burial pottery which is discussed by C. F. C. Hawkes, and a human skeleton, described by A. J. E. Cave, remarkable both from the pathological point of view and as material from a period in which in England evidence of the physical characters of the people is scarce. Eggington is three miles east from Leighton Buzzard, and the site a sand bed on the top of the galt hill which has been worked since the Middle Ages. The skeleton lay supine with the right arm flexed across the breast. The left arm, which evidently had lain in the same position, was missing. The legs were drawn up to the left. The skeleton was that of an adult man, strong and vigorous, but short of stature, not exceeding 5 ft. 3 or 4 inches. Pathological changes indicated arthritic affections of the vertebræ and also, severely, of the temporo-maxillary joints, the latter indicating that movements of the jaw in lifetime must have been difficult. The right fibula had been fractured at the junction of neck and shaft and in the right tibia was a serious traumatic lesion at the distal end indicating acute osteomyelitis about 3 inches above the ankle joint. An incised wound on the shin caused by a sharp implement had penetrated to the medullary cavity and the gash had never closed. Although there evidently had been local infection and suppuration, the section had recovered well. The skull is broadly ovoid with a short vertical frontal and a full well-rounded occipital region. The moderate superciliary ridges are short and confluent. The facial skeleton is broad and squared, the nose moderately wide with a well-formed projecting bridge. The skull is micrognathic, and just outside the brachycephalic group: index 79, length 173 mm., breadth 135 mm., auricular height 112. Mr. Hawkes's analysis of the characters of the two pottery vessels which it has been possible to reconstruct points to a period of decadence in Iron Age *A* with suggestions of Iron Age *B* influence in a late pre-Belgic epoch, that is, late third to second century B.C.

Snake Vessel from South-Central Africa

NOTWITHSTANDING the significance of the serpent among Bantu-speaking and other peoples throughout Africa, to which attention has been directed by Sir James Frazer, the occurrence of snake vessels among these peoples does not appear to have been noted in the literature. An unusually interesting specimen has been figured and described by C. van Riet Lowe (*Man*, August 1940). It was bought recently from an itinerant hawker at Mufulira in the 'Copper Belt' of Northern Rhodesia. The vessel is modern, of well-baked clay with an unusually fine finish under a graphite slip. The lid is surmounted by a sphinx-like head with characteristic turban head-dress set in coronets that includes the indented designs of ten cowrie shells, each shell in a separate compartment. On the lower portion of the cylindrical neck of the vessel are two rows of cowrie shells, fourteen indented in each row, while five similar shells appear on the handle. The spherical body of the vase, about 10 inches in diameter, contains three serpents in high relief; on one side a serpent is in the act of swallowing its fellow; on the other side a serpent is shown swallowing a frog. The interesting spout is cylindrical, and includes four rectangular perforations in the circular diaphragm at the end. These do not penetrate directly into the body of the vessel, but follow the coil seen in the front view of the pot. While in certain respects it resembles specimens described from Crete and India, it differs in regard to its lid and coiled spout, but at the same time it has their multiple spout and the serpent. It would appear then that, if there is contact between Crete and India, the influence of the old snake cult may also have extended to south-central Africa.

Pearl Formed Around a Rotifer

THE formation of pearls by molluscs is probably induced more frequently by inorganic irritants than by the presence of animal remains, although both Herdman and Jameson claimed that the responsible agent was generally a parasitic worm. In 1856, Kuchenmeister reported the discovery of a water-mite within a pearl, but records of the occurrence of a free-living animal as a nucleus are very rare. A. E. Alexander describes a rotifer, *Atrochus tentaculatus*, which he found in the central cavity of a freshwater pearl weighing 30 grains (*Amer. J. Sci.*, **237**, 920; 1939). The rotifer measured 0·375 mm. in length, and its chitinous material was well preserved (15 tentacles being represented) indicating rapid deposition of the pearl material. This would appear to be the first record of the presence of a rotifer inciting the formation of a pearl. Curiously enough, the author omits to mention the kind of mollusc from which the pearl was obtained.

Brown Rot Fungi of Fruit Trees

IT has been assumed by Continental workers that, of the brown rot diseases of fruit trees, *Monilia fructigena* (= *Sclerotinia fructigena*) is almost confined to pome fruits, and *M. cinerea* (= *S. laxa*) to the stone fruits. Dr. H. Wormald shows, however (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 20–28, June 1940), that this is not so in Great Britain. He has succeeded in effecting cross inoculations from apple to plum, quince to apple and plum to apple and pear for *M. fructigena*. An extensive series of successful inoculations has also been made with *M. cinerea*, for example, from plum to pear to apple, and the fungi have also been found on a number of species of ornamental shrubs. It is possible to regard *M. cinerea* as the cause of blossom wilt of fruit trees and ornamental shrubs of the genera Pyrus and Prunus, whereas *M. fructigena* is the fungus most frequently associated with fruit brown rot. The paper indicates a number of hitherto unsuspected sources of infection and should make future control of the diseases more certain.

Control of Moulds on Citrus Fruit

J. E. VAN DER PLANK, *et al.* (*J. Pom. & Hort. Sci.*, **18**, 135; 1940), have described experiments on the use of paper impregnated with *o*-phenylphenol for wrapping citrus fruits. These wraps successfully reduced the number of fruits infected with *Penicillium digitatum P. italicum* and *Trichoderma lignorum.* 5 mgm. *o*-phenylphenol per sq. ft. of paper reduced infections by a half; 9 mgm. (0·44 per cent of the paper weight) gave 87 per cent reduction, but amounts in excess of this caused injury to the rind. Lemons were less easily injured than oranges or grape-fruit. Glyceride oils incorporated in the wrap allowed the use of more preservative without causing injury, and did not reduce the efficiency of the preservative. The wraps are odourless and colourless. They do not taint the fruit or reveal the presence of preservative, which has the advantage of being cheap.

Branchiobdellidæ from North America

THE first adequate description of this striking group of Oligochæte worms was furnished by Odier nearly 120 years ago and this author considered them to be leeches as did other authorities for the next 80 years. From their association with crayfish, they have been and still are by some zoologists regarded as parasites. C. J. Goodnight (*Cont. Zool. Lab. Univ. Illinois,* No. 537; 1940) has furnished a review of the family in North America, where, as is well known, crayfish are numerous. In it 21 species divided among 9 genera are recognized and described. The author concludes from the examination of the contents of the alimentary canals of a large number of specimens that the favourite food at all stages is diatoms. From the records provided it also seems clear that little, if any, host specificity is shown by the Branchiobdellidæ. The fauna of the west coast area is closely related to that of the oriental region.

Piedmont Glaciers

THE piedmont or fringing glaciers of the Antarctic islands around Graham Land have been described by E. Gourdon, on the west of Graham Land, J. H. H. Pirie on the South Orkneys and O. Holtedahl on the South Shetlands, etc. In a recent paper (*Geog. J.*, August), the Rev. W. L. S. Fleming returns to the problem as regards the islands visited by the British Graham Land Expedition of 1934–37. Mr. Fleming argues that the theory of Holtedahl which attributes these glaciers to nivation erosion by freeze and thaw action along the headwall is inadmissible. Many lie below the snow line, all have relatively lofty cliffs at their faces, calving is restricted to the upper parts of the cliff and practically none has moraine matter in its basal layers. Mr. Fleming believes that from these and other characteristics these glaciers, which he terms fringing glaciers, show evidence of being relics of a former more extensive sheet of ice. Their thickness shows no definite relation to the width of gathering ground and in several places the glaciers still show connexion with areas of shelf-ice which may be regarded as relics of a former ice sheet that once filled all the bays and extended beyond the off-lying islands. This would explain the present frontal ice cliff which is sometimes as high as 200 ft. Mr. Fleming does not discard entirely the theory that these glaciers have eroded the platforms on which they rest, but he finds certain difficulties in the acceptance of the idea of which the principle seems to be the absence of moraine material in the ice. This lack of evidence of erosive action was admitted by Holtedahl, but he seems to have been satisfied by the discovery of a few englacial boulders in some ice fronts that it was not an insuperable objection to his theory.

Spectrographic Analysis of Singly Ionized Praseodymium

A PAPER entitled "Zeeman Effects and Preliminary Analysis of Singly Ionized Praseodymium (Pr II)" was presented by G. R. Harrison and N. Rosen at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The magnetic resolution of spectrum lines emitted by the singly-ionized praseodymium atom has been studied at fields up to 95,000 gauss, using a 1,700-kilowatt Bitter electromagnet. Three concave gratings of 10-metre radius were used simultaneously to photograph the spectrum between 2200 A. and 8000 A., giving dispersions of 0·8 A./mm. for the ultra-violet range and 1·6 A./mm. for the visible and near infra-red. The wide hyperfine structure and complicated overlapping of many of the Zeeman patterns render their separation difficult, but several hundred patterns have been reduced to obtain information about spectral terms. Many intense lines are found to be multiplet second-order satellites, indicating wide departures from *LS* coupling, as is to be expected. An unusual number of terms having the same *g*-values are found, possibly indicating a degradation of many terms to a common value through strong mutual perturbations between them. Since the spectrum is rich in lines and of intermediate coupling, no single method of analysis is found sufficient, and it is only by the combined use of improved wave-length measurements, hyperfine structure analysis, Zeeman effect analysis and excitation studies that the many possible quadratic arrays, which applications of the combination principle through the interval sorter and recorder have brought to light, can be critically compared. By using all of these methods a rapidly growing array involving several hundred lines has been set up.

Van der Waals Adsorption of Gases

ACCORDING to S. Brunauer, L. S. Deming, W. E. Deming and E. Teller (*J. Amer. Chem. Soc.*, 62, 1723; 1940) there are five types of van der Waals adsorption isotherms, typified by the adsorption of (i) oxygen on charcoal at – 183°, (ii) nitrogen on iron catalysts at – 195°, (iii) bromine on silica gel at 79°, (iv) benzene on ferric oxide gel at 50° and (v) water vapour on charcoal at 100°. In the isotherms the volume of gas adsorbed is plotted against the pressure. The first type is the Langmuir isotherm for a unimolecular layer. The authors derive an equation which covers all five types of curve, in which adsorption in capillaries is envisaged and importance is attached to the difference between the heat of adsorption in the first layer and the heat of liquefaction of the vapour (corrected by an additional energy for the last adsorbed layer in a capillary, which is attracted from both sides). The equation is too complicated to reproduce, but it is shown to cover the experimental results and it contains only four constants. It extends the usual theory of capillary adsorption (Kelvin equation) by considering partly filled as well as empty and filled capillaries, and it is shown to provide a useful orientation over a wide range of experimental material. It also includes as special cases unimolecular adsorption and multimolecular adsorption on free surfaces, as well as adsorption in capillaries.

ELECTRICAL PHOTO-ENGRAVING

MR. T. THORNE BAKER describes in the *Electrical Review* of August 23 a new phase of facsimile reproduction for newspaper printing. A study of the literature of early telegraphic transmission of pictures shows that inventors were directed long ago towards the possibilities of receiving a telegraphed image directly upon a soft metal sheet, a cutting tool (operated electro-magnetically by the receiving currents) making an intaglio image which could be printed forthwith. Recent literature on the subject shows that the general opinion nowadays is that it is more profitable to transmit a continuous-tone image from which the screen picture for reproduction can be made by the ordinary methods.

It has been proved that by transmitting a picture by photo-electric scanning to another cylinder rigidly attached to the scanning cylinder, a new means has been established of reproducing photographs which eliminates the camera. This method has opened up a most important field which is likely to have far-reaching effects upon the photo-engraving industry. It applies equally to black-and-white work and colour, and offers, for the first time in photographic reproduction history, a means of reproducing almost perfect copies of any original with little of the 'retouching' and 'fine etching' which to-day makes photo-engraving unnecessarily costly.

In the usual method, the original photograph is attached to the drum of the sending instrument and the surface is scanned by a beam of light which is made to trace a spiral path round the drum, the light after refraction by the picture tones being reflected back on the photo-cell. The amplified output currents from the cell are transmitted to the distant receiving instrument, where they operate a light-valve which exposes a sensitive film, or makes an electromagnetically actuated stencil mark the paper through a sheet of ordinary carbon paper. An alternative method is to use the received currents to operate a high potential glow lamp, the rays of which are concentrated through a tiny aperture upon the surface of the sensitive paper.

Recent sensitometric investigations have indicated the exact losses in tone rendering when making half-tone reproductions by ordinary methods of photo-engraving, in both the high-lights and shadows of the image. In the ordinary way these are overcome by retouching the original, skilled manipulation of the negative, and fine etching of the metal block. It is possible to bias the currents from the scanning unit so as to put back, as it were, what is lost in photo-mechanical reproduction processes. Selecting suitable portions of the characteristic curves of the valves used in amplification, and using the photo-cells themselves under selected conditions, makes it possible to add to or take away from the tones of the facsimile image at any desired densities.

One method of obtaining this result is embodied in a newspaper engraving unit and made by the author for a provincial American newspaper. A transparent film is attached to a drum, actually a glass cylinder, and light from a lamp is focused by a lens, so that the rays come to the periphery of the cylinder. The light beam, after passing through the photographic original, is spread by a negative lens so as to fall on three photo-cells P_1, P_2 and P_3. Cell P_2 gives a straight line reproduction of the image over most of the inner tones. Cell P_1 is so arranged electrically that it records the high-light tones only, and adds density to the upper part of the reproduction curve in the manner indicated by Tritton and Wilson, in the *Photographic Journal* of June 1939. Cell P_3 similarly adds densities in the shadows. The currents from the three cells after amplification are mixed and made to operate a glow lamp, to the rays which the receiving film is exposed. In this way a biased reproduction is obtained, which when received by the half-tone screen in the process camera, yields a half-tone negative from which a block can be made that will give 'perfect' tone rendering without hard work. The *Trenton Times* (New Jersey, U.S.A.), which has adopted the system, prints high-speed offset lithographic four-colour pictures with 120-line screen at 45,000 copies per hour, which is something unique at present in newspaper printing. The primary purpose of the system is to speed up the making of half-tones for newspaper printing.

THE THEORY OF ADSORPTION ON SQUARE LATTICES

By DR. J. K. ROBERTS,
DEPARTMENT OF COLLOID SCIENCE, CAMBRIDGE

IN a recent paper L. Tonks[1] has criticized the application of the Bethe method to the solution of problems in adsorption. I. Langmuir[2] had earlier mentioned the criticism and supported it. I have already given an answer[3] to Langmuir's remarks so far as was possible before the appearance of the paper by Tonks.

We are concerned with the adsorption on a square lattice of particles so large that, if one site is occupied, adsorption cannot take place on the four surrounding sites. Thus, if a particle is on site *o* in Fig. 1, adsorption on the four sites marked *a* is excluded.

Bethe's method depends on the selection of a small group of sites on which all possible configurations of adsorbed particles are considered, and suitable parameters are introduced to take account of the effect of the particles outside the group on those within it, and *vice versa*. Thus in Fig. 1, if we call site *o* the central site, and the sites marked *a*, *b*, *c* first shell, second shell and third shell sites respectively,

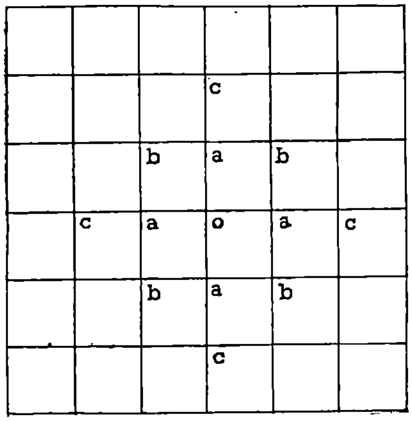


Fig. 1.

Sites on a square lattice shown by the intersections of the lines.

the first approximation would be obtained by considering in detail the central and first shell sites, the second approximation by considering the central, first and second shell sites, and the third approximation by considering the third shell sites also.

It is evident that the first approximation does not include enough detail to give a satisfactory picture of the behaviour of the film. For another special purpose and in connexion with a different type of lattice I considered a group of sites equivalent to the central and first shell sites together with two of the *b* or second shell sites diagonally opposite each other and obtained the form of the isotherm. I have pointed out[3] that this, which is really a freak case, is a very crude application of the Bethe method to the present problem of determining the isotherm, but in spite of this it is a considerable improvement on the first approximation, and gives reasonable results until the film is rather more than half complete, $\theta = 0{\cdot}25$. Tonks is quite right in pointing out that this isotherm is inaccurate at higher values of θ, the fraction of sites occupied, and I agree with him that I should not have extended the θ, ξ relation (where ξ is proportional to the pressure p) as far as I did.

In the paper already cited[3] I gave a comparison between the isotherm using the Bethe second approximation and that obtained using some formulæ of Tonks which Langmuir[2] quoted. It is this second approximation against which Tonks's criticism is mainly directed, partly on the grounds that certain parameters do not behave in the way he would expect them to behave. This is a technical point which cannot be discussed in the space available here. I will consider it in a paper which I am submitting for publication (*Proc. Camb. Phil. Soc.*) and will confine myself now to consideration of the final result, namely, the form of the isotherm. This is shown by the full circles in Fig. 2 with the curve drawn through them, and the points with crosses show the isotherm that would be deduced from the formula of Tonks. Below $\theta = 0{\cdot}15$ the two are indistinguishable. The second ground for Tonks's objection (see p. 481) is that he found the Bethe method unworkable beyond the second approximation so that the accuracy of the second approximation could not be checked nor could higher accuracy be obtained. The third approximation is correctly formulated, as follows. We introduce parameters ξ, ε_1, ε_2, ε_3 for each particle on central, first, second and third shell sites respectively. These sites must all be average sites, which gives the relations

$$\begin{aligned}\xi(1+\epsilon_2)^4(1+\epsilon_3)^4 &= \epsilon_1\{\epsilon_1{}^3+3\epsilon_1{}^2(1+\epsilon_3)+\epsilon_1(3+2\epsilon_2)\ (1+\epsilon_3)^2+\\ &\qquad (1+\epsilon_2)^2(1+\epsilon_3)^3\}\\ &= \epsilon_2(1+\epsilon_2)(1+\epsilon_3)^2\{\epsilon_1{}^2+2\epsilon_1(1+\epsilon_2)(1+\epsilon_3)+(1+\epsilon_2)^3(1+\epsilon_3)^2\}\\ &= \epsilon_3(1+\epsilon_3)\ \{\epsilon_1{}^3+\epsilon_1{}^2\ (3+2\epsilon_2)\ (1+\epsilon_3)+3\epsilon_1(1+\epsilon_2)^2(1+\epsilon_3)^2+\\ &\qquad (1+\epsilon_2)^4(1+\epsilon_3)^3\}\\ &= \{\theta/(1-\theta)\}\ \{\epsilon_1{}^4+4\epsilon_1{}^3\ (1+\epsilon_3)+2\epsilon_1{}^2(3+2\epsilon_2)\ (1+\epsilon_3)^2\\ &\qquad +4\epsilon_1\ (1+\epsilon_2)^2(1+\epsilon_3)^3+(1+\epsilon_2)^4(1+\epsilon_3)^4\}\end{aligned}$$

These equations constitute the solution, and give ξ, ε_1, ε_2, ε_3 as functions of θ. The relation between θ and ξ, the isotherm from the third approximation, is shown by the open circles in Fig. 2, and it will be seen that the agreement with the second approximation is very close. The values of ξ for the third approximation points *A* and *B* differ by less than 10 per cent from the second approximation, while the Tonks points in the same region differ from it by about 50 per cent of their value.

The reason for the discrepancy is in part the following. To carry through Tonks's treatment for $\theta > 0{\cdot}25$ it is necessary to express certain probabilities, for example, that site *o* and all the *b* and *c* sites in Fig. 1 are occupied together explicitly as a function of θ. He assumes that this probability is proportional to θ^9. This is only true if one assumes that the only sites on which atoms are adsorbed at all are 'even' sites, and such an assumption is only valid in the extreme limit when $\theta \to 0{\cdot}5$. The trouble is that, if one makes this assumption, one is neglecting terms of the same order as those one is trying to calculate. The assumption underlies and invalidates the whole of the Tonks treatment for $\theta > 0{\cdot}25$ except in the extreme limit mentioned. In this extreme limit Tonks' method of approach shows that the isotherm is of the form $\xi = 2\theta/(1-2\theta)$—a useful result. It is, of course, the trouble discussed in this paragraph that Bethe's approximation is designed to overcome.

On p. 479 of his paper Tonks makes the following statement: "This analysis has recently been made by Roberts (*Proc. Camb. Phil. Soc.*, 36, 53 (1940)) . . . the nature of the failure of the statistical method is not analysed, but Roberts resorts to an empirical method to handle values of θ_R greater than $0{\cdot}25$. He does not seem to recognize that this technique

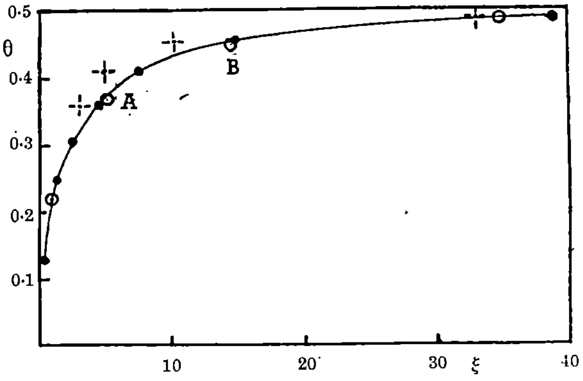


Fig. 2.

Relation between θ the fraction of sites occupied and ξ which is proportional to the gas pressure. The film is complete when $\theta = 0{\cdot}5$. Full circles, Bethe 2nd approximation; open circles, Bethe 3rd approximation; crosses, Tonks.

does not lead to true equilibrium conditions." This statement is wholly false and misleading. In 1935[4] I pointed out that, when an immobile adsorbed film is formed in which each particle in the gas phase occupies more than one site on the surface, the final or complete film will have holes or gaps in it. By an immobile film is meant one in which the energy of activation required to allow a particle to move from one site to another is so much greater than kT that for the duration of an experimental investigation the particles may be regarded as remaining fixed on the sites on which they are first adsorbed. Such films are clearly not in a state of true equilibrium[5] and it was precisely because of this that, in the paper to which Tonks refers, the concern of which was to investigate the properties of these immobile, non-equilibrium films, I used the empirical model to obtain the required results. Its use had nothing whatever to do with the breakdown of the statistical method in the sense used by Tonks. At low values of θ, the properties of the equilibrium and non-equilibrium films will not differ greatly and the statistical method can be used, but at higher values of θ, where the differences are significant, the model must be used. This is clearly stated in the last paragraph on p. 63 of my paper. I may add that I purposely did not plot the isotherm in the paper because for the non-equilibrium film it has no significance. It may be mentioned that now that the third approximation has been worked out, it will be possible to improve the calculations given in my paper (see the footnote on p. 58 of it).

So far, we have been concerned with the effects that arise when the adsorption of a particle on a given site excludes the possibility of adsorption on certain neighbouring sites. The Bethe method is particularly suitable for dealing with this problem. It can also be used to take account of the effects of mutual forces between adsorbed particles and to determine how the heat of adsorption varies with θ, but here, particularly when the forces are repulsive, it suffers from a limitation which I have pointed out[5] and which is quite different from anything discussed by Tonks. In applying the method it is necessary to assume that the interaction energy between particles adsorbed on neighbouring sites is fixed. When account is taken of the fact that the interaction energy is a continuous function of the distance between the particles and that the potential energy of a single adsorbed particle is a continuous function of its position on the surface, it can be seen, as will be shown in a paper by A. R. Miller and myself, which will be published shortly, that the results given by the Bethe method require modification. This has the important practical result that it can no longer be regarded as a necessary consequence of the nature of the observed variation of heat of adsorption of hydrogen on tungsten with θ that this hydrogen film is immobile.[5] I have always felt some difficulty in accepting the truth of this immobility, particularly in view of the fact that the hydrogen film evaporates at an appreciable rate at a comparatively modest temperature.

[1] Tonks, L., *J. Chem. Phys.*, 8, 477 (1940).

[2] Langmuir, I., *J. Chem. Soc.*, 533 (1940).

[3] Roberts, J. K., *J. Chem. Soc.*, 773 (1940).

[4] Roberts, J. K., NATURE, 135, 1037 (1935); *Proc. Roy. Soc.*, A, 152, 473 (1935).

[5] Roberts, J. K., "Some Problems in Adsorption", 23, 38, 33, 34, Camb. Univ. Press (1939). The pages are given in the order in which they are referred to in this communication.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

How we shall Win. Pp. 16. (London: Federal Union.) [278

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 2, No. 18: On the Histogenesis of some Teleost Pituitaries. By T. Kerr. Pp. 224–244. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s.* 9*d.* [288

British Association for Labour Legislation. Report on Welfare and Health in relation to Hours of Work and Output in War-time. Pp. 36. (London: British Association for Labour Legislation.) 6*d.* [288

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 18th July 1940. Pp. 32. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [308

London School of Hygiene and Tropical Medicine (University of London), incorporating the Ross Institute. Report of a Meeting of the Ross Institute Industrial Advisory Committee held in the Council Chamber of the Rubber Growers' Association on Tuesday, 6th August 1940. Pp. 28. (London: London School of Hygiene and Tropical Medicine.) [308

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 9, No. 21: A New Cardinal from Central Lower California, Mexico. By Laurence M. Huey. Pp. 215–218. Vol. 9, No. 22: A New Form of Pocket Gopher (Thomomys) from the Santa Cruz Mountains, California. By Laurence M. Huey. Pp. 219–220. Vol. 9, No. 23: A New Coastal Form of Brush Rabbit from the Vicinity of San Quintin, Lower California, Mexico. By Laurence M. Huey. Pp. 221–224. Vol. 9, No. 24: A New Species of Legless Lizard from San Geronimo Island, Lower California, Mexico. By Charles E. Shaw. Pp. 225–228. (San Diego, Calif.: San Diego Society of Natural History.) [218

Papers of the Michigan Academy of Science, Arts and Letters. Vol. 25 (1939). Pp. xiii+643. (Ann Arbor, Mich.: University of Michigan Press; London: Oxford University Press.) 28*s.* net. [268

Records of the Indian Museum. Vol. 23: Anthropological Observations on the Anglo-Indians of Calcutta. Part 3: Statistical Analysis of Measurements of Seven Characters. By P. C. Mahalanobis. Pp. 151–188. (Delhi: Manager of Publications.) 1.10 rupees; 2*s.* 6*d.* [268

Memoirs of the Indian Museum. Vol. 13, Part 2: Scientific Results of the Yale North India Expedition. Biological Report No. 19: Freilebende Ruderfusskrebse (Crustacea Copepoda) aus Nordwest und Südindien (Pandschab, Kaschmir, Ladak, Nilgirigebirge). Von Friedrich Kiefer. Pp. 83–204. (Delhi: Manager of Publications.) 5 rupees; 8*s.* [268

East African Agricultural Research Station, Amani: Tanganyika Territory. A Report on a Journey to parts of the West Indies and the United States for the Study of Soils, February to August 1938. By G. Milne. Pp. 78. (Dar es Salaam: Government Printer.) 2*s.* 6*d.* [268

Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the Year ending 30th June 1939. Pp. iv+144. (Delhi: Manager of Publications.) 3.3 rupees; 5*s.* 3*d.* [268

U.S. Office of Education: Federal Security Agency. Pamphlet No. 87; Negro High-School Graduates and Nongraduates; Relation of their Occupational Status to certain School Experiences. By Ambrose Caliver. Pp. iii+19. (Washington, D.C.: Government Printing Office.) 5 cents. [268

Ceylon. Sessional Paper 8, 1940. Report and Accounts of the Coconut Research Scheme for 1939. Pp. 21. (Colombo: Government Record Office.) 25 cents. [268

Canada: Department of Mines and Resources: Mines and Geology Branch. National Museum of Canada Bulletin No. 92 (Biological Series No. 24): Botany of the Canadian Eastern Arctic. Part 1: Pteridophyta and Spermatophyta. By Nicholas Polunin. Pp. vi+408+8 plates. 1 dollar. National Museum of Canada Bulletin No. 96 (Biological Series No. 25): A Biological Investigation of the Thelon Game Sanctuary. By C. H. D. Clarke. Pp. iv+135+25 plates. 50 cents. (Ottawa: King's Printer.) [268

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography. Geological Survey Memoir 223: Mineral Resources, Hazelton and Smithers Areas, Cassiar and Coast Districts, British Columbia. By E. D. Kindle. (No. 2455.) Pp. iii+107+4 plates. (Ottawa: King's Printer.) 25 cents. [268

Catalogues

Soluble Hexobarbitone B.D.H.: an Anaesthetic for Intravenous Injection. Pp. 2. Hexobarbitone B.D.H. Pp. 2. (London: The British Drug Houses, Ltd.)

Apiezon Products: The Ideal Oils, Greases and Waxes for Vacuum Work. Folder of 6 pp. (London: W. Edwards and Co.)

Catalogue of Books and Journals on Zoology, Biology and Geology. (No. 576.) Pp. 70. Catalogue of Books and Journals relating to Mathematics and Physics. (No. 579.) Pp. 50. A Supplement of Scientific Books. (No. 14, 1940.) Pp. 16. (Cambridge: W. Heffer and Sons, Ltd.)

Lovibond Comparators for Colorimetric Analysis. Pp. 16+iv. (Milford, Salisbury: The Tintometer, Ltd.)

The Cost to Industry of the Common Cold. Pp. 16. (Greenford: Glaxo Laboratories, Ltd.)

Editorial & Publishing Offices :
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

NATURE

Telegraphic Address :
Phusis, Lesquare, London

Telephone Number :
Whitehall 8831

Vol. 146 SATURDAY, SEPTEMBER 21, 1940 No. 3699

HEALTH AND INDUSTRY

THE health and welfare of the industrial worker at all times is of vital importance to the State for many reasons. To maintain a satisfactory output and to contribute to the trade and wealth of the nation the workers must be as efficient as the machines they control. Fatigue and disease mean diminished efficiency or absence from work. Hours of work lost interfere with industrial resources, and are a source of considerable national financial loss. In order to treat the sick workers, health services and medical care have to be provided directly or indirectly at national expense, sickness benefit has to be paid out and so forth.

During the last twenty-five years much legislation has been passed dealing with factories and workshops, dangerous trades, and other industrial hazards in which the workers and especially young and female workers are protected against protracted hours of labour, and against accidents by machinery, and in which, also, the health of employees is conserved by compulsory sanitary conditions of workshops and factories. This is especially true of productive industries in which the commodity is made out of the raw material. A great impetus to progress was made in the War of 1914–18 through the Health of Munition Workers Committee, which studied especially the relation of hours of work to output, watched the relationship between hours of work and health and efficiency and issued recommendations from time to time. In 1918, on the dissolution of that Committee, a new body known as the Industrial Fatigue Research Board was formed to continue, under the auspices of the Medical Research Council, the work already begun and to extend it on more systematic and scientific lines. Its title was changed in 1928 to Industrial Health Research Board.

Research into the hazards of industry and their prevention has been conducted for many years by the Home Office, the Local Government Board and its successor the Ministry of Health, the Medical Research Council and the Industrial Fatigue Board. The results of these researches have been practically applied, and have protected the worker from diseases which formerly caused a high industrial mortality, such as lead poisoning and mule-spinner's cancer, while much has been achieved in the reduction of dust diseases, for example, silicosis and asbestosis. The problems of fatigue and monotony in work have been intensively studied.

These are the fruits of peace. In war-time new conditions prevail and new problems arise.

The British Association for Labour Legislation has issued a Report on Welfare and Health in Relation to Hours of Work and Output in War-time, which as a reasoned presentation of its subject will repay careful study.*

In the first place it considers the question of hours of work and efficiency. This subject was dealt with recently in our columns.† The report emphasizes that in the process of prolonging hours of work a point is reached at which any further extension will not only impair health, but will also lead to a fall in hourly output and a drop in total production. This lesson might well be learned by those who engage in mental as well as manual work. It is often insufficiently appreciated that muscular fatigue is associated with mental fatigue.

---

* Report on Welfare and Health in Relation to Hours of Work and Output in War-time. (British Association for Labour Legislation, 21, Clareville Grove, London, S.W.7.) 6*d.*

† NATURE, 145, 108; 1940).

This was shown experimentally by Gustav Mann more than forty years ago. The converse is also true, and the brain worker who engages in strenuous exercise at the week-end is thereby sapping his stores of mental energy.

Another matter discussed in the report relates to the employment of children and young persons. Here it is important to realize the strain which conditions of work and environment may throw upon the adolescent.

Next the report treats of the promotion of health and welfare. The important subjects of adequate nutrition and well-cooked food are considered, mess-rooms, canteens and communal feeding centres are reviewed, billeting of workers and ventilation and lighting during the black-out are discussed. A series of practical recommendations on all these matters closes the report.

Even as the report appears, new measures have been taken by the Ministry of Labour and National Service to promote industrial welfare. There is a scheme to cut down working time to 55 or 56 hours a week, factory inspectors have been instructed to enforce the Factories' Act in the care of women and young persons and an Order has been made by the Minister requiring the occupier of any named factory to make arrangements for part-time or whole-time medical men, nurses and officers to supervise the welfare of the persons employed. The necessity will be determined by the number of workers employed in a given factory or by special conditions such as dangerous processes or isolated position in a factory. Already some three hundred medical men and women—fifty of them in a whole-time capacity—are attached to factories and business organizations in Great Britain and there is a responsible Association of Industrial Medical Officers.

The position created by this Order is of great importance. It is State recognition of preventive medicine as a function of works management, and the extended application of the results of scientific and medical research for the benefit of the industrial workers should make a substantial contribution to national health. The Order is a beginning, but it has great possibilities. It must be remembered that workers spend only a portion of their lives in the factory, and that to safeguard their health and efficiency preventive medicine must take account of their social environment. In other words, industrial hygiene must not work in water-tight compartments but must be closely co-ordinated with the national health services provided by local authorities and the national health insurance service, all working under the auspices of the Ministry of Health. Otherwise there will be waste of effort, overlapping and duplication of health services and unnecessary expenditure.

TEACHING OF ECONOMIC BIOLOGY

THE intensification of the present conflict has brought with it many problems and none more poignant than its effects upon children. To a developing child the significance of the War is often either resolved into a singular, fervent and intense hatred of the Nazi machine that has so considerably inconvenienced its peculiar world or, very frequently with adolescent children, a confusion of ideas that leaves them groping for a clearer understanding of the deeper issues involved. The traditional and time-honoured British policy of abandoning political factions at the school portals is an admirable one that shows no sign of being relaxed despite the bitterness and mendacity of enemy propaganda. Economic factors, however, have become so paramount in importance that with daily Press references to the blockade, the repeated aerial attacks on merchant shipping and the civilian population, and the ruthlessness of the inhuman submarine warfare, their effects upon the child mind cannot be ignored. On these and related topics, further assistance from their teachers is constantly demanded by ardent youthful inquirers.

The opportunities presented here to the geography and domestic science teachers are manifold and clear. The co-operation of other teachers in illustrating this economic picture is not so frequently invoked nor even envisaged. Yet the role of the mathematics or science teachers is none the less essential in presenting a composite picture of the interlacing economic network. The biology teacher, particularly, is able to play an effective part in relating descriptions of essential commodities to their natural economy and source of origin. In times of peace, the teaching of economic biology has been adopted in surprisingly few schools in Great Britain, although in those schools where such instruction has been given its introduction has been acclaimed as a definite acquisition to the more realistic nature of the curriculum. In war also a greater extension of the teaching of some of the economic aspects of biology would be of inestimable value in facilitating the adjustment of individual to the changing needs of our rapidly evolving society.

The argument for the teaching of applied biology with reference to the economic needs no flogging. It would serve to quicken the interest of the pupil in articles that he is constantly seeing. It should enable him to become more familiar with the interwoven relationships between all living organisms. Latex and rubber, leather, spices and condiments, perfumes, tobacco, dyestuffs, beverages, soap and drugs could all be described in relation to their natural economy as also could certain bacteria, particularly those which are helpful to man like cheese-ripeners, tobacco-maturers, etc. References to the constantly changing methods by means of which man is making greater economic use of plants and animals should do much towards helping the child to appreciate the uniqueness of man as a successful exploiter and utilizer of many different aspects of his environment, in contrast to the circumscribed range of other living organisms. The presentation of these and related topics in a historical setting affords wide scope for the building up of attitudes which would in part enable a child to appreciate the dynamics of social change.

The present restrictions in consumption of certain food products offer special opportunities to the adaptable teacher. Rationing of staple commodities like tea, sugar, butter, and bacon could be made the basis of lessons on the place of these foodstuffs in general nutrition and economy. These might be linked up with the campaign being carried out by the Ministry of Food, which could be made use of in emphasizing the fact that suggested substitutes are not necessarily inferior in food value to articles which have been accepted as almost a part of the national heritage. (The word *Ersatz* has been partly instrumental in creating the impression that substitute foods are of lower nutritional standard than the ones they are designed to replace.) In conjunction with the geography specialists, other lessons could be used to describe the source of origin, methods of production and distribution of necessary food-stuffs, articles of clothing, footwear, etc.

Descriptions of the transport of food products like meat, fruit and fish would scarcely be complete without reference to the various methods of conditioning and preservation. Drying, smoking, salting, canning and other processes which alter the appearance and taste of the food product could be considered with reference to food substances that frequently form a part of the dietary of the child. Lessons on dried figs, bacon and ham, kippers and bloaters, fruit, vegetable and fish canning, etc., would be particularly effective in emphasizing the unique place of man as an unraveller of the—to him—tangled skeins of Nature and as one who has learned to mould her pattern to his own design. The preservation of foods in their more or less natural state by the more recently developed cold-storage devices would also form an invaluable introduction to an account of the growing interdependence of the various components of the British Empire.

The limitations of ice as a natural preservative —although the caviare taken to ancient Egypt embedded in the snow of the Caucasus apparently had lost little of its appeal to the recipients—and the introduction of machinery to produce cold artificially could be used to show how, some fifty years ago, mechanical refrigeration was first applied to the storage of food. The growing scarcity of meat in Great Britain in the seventies of the last century, due largely to the rise of industrialism, coupled with the urgent need to find a profitable outlet for the large quantities of food materials in the producing countries like Australia, New Zealand and South America, could demonstrate how the economic problems led to the first attempts at installing refrigerating machinery in ships to bring frozen meat from overseas. The necessity of refrigeration assumes added importance to-day with the diversion of merchant ships from their customary trade-routes.

The excellent series of posters now widely distributed throughout the country in which attention is directed to the raw materials produced by various parts of the British Empire would be useful starting points in lessons that would foster a better understanding of the vital inter-relations between Dominions, Colonies, Dependencies and the mother country.

In teaching children about articles they eat and drink and in which they clothe themselves, a valuable link is made in introducing them to a wider appreciation of the lives lived by other people in different climatic regions. The absolute necessity of the reindeer to Laplanders as a provider of food, clothing, utensils and fuel, and the complete dependence of natives of Papua upon shellfish and yams are examples of how the story of civilization might be re-lived in the classroom.

Greater attention might also profitably be paid to the economic aspects of biological control. The late Mr. Frederick Muir's estimation that the introduction of the Tachinid parasite of the weevil borer of sugar cane into the Hawaiian Islands saved the cane growers about one million pounds a year is a spectacular example of the inscriptions that might be given to illustrate the potentialities of control of pests by biological methods. This could be adequately supplemented by discussions more prosaic, but none the less important and effective, of the methods of control which have been originated and which are being constantly extended at the Laboratory of the Imperial Institute of Entomology at Farnham Royal. The value of the film in augmenting the learning process by providing visual experiences beyond the concept of words springs readily to mind in considering this issue. An outstanding film on prickly pear control produced by Australia Trade Publicity would be invaluable in presenting a picture of man's ceaseless fight against natural forces in his march towards civilization.

The remarkable plagues of insects which occur from time to time, as instanced by the appearance of flying ants in amazing numbers in the streets of Croydon recently, and other cyclical fluctuations of animal populations would be useful in bringing out the importance of the effects of the alternate abundance and scarcity of organisms upon which human life is dependent. Price variations, together with the need for investigating the causes of scarcity and the introduction of corrective and ameliorative methods, could be considered in connexion with lessons on the fickleness of Nature in providing a dearth of life-giving crops interspersed with seasons of plenteous bounty.

The introduction of a more liberal use of economic biology in the school syllabus would have a further advantage in dispelling the unfortunately too prevalent belief that practical biological experiments and demonstrations can only be taught by using stock equipment and apparatus which are usually of an expensive type. Discussion of topics concerning articles that form part of our everyday habitat could be illustrated quite adequately by practical observations making use of the articles themselves. The question often debated as to whether the teaching of science should either focus upon the inculcation of mental discipline or should play a more considerable part in introducing the student to the wider human and social aspects of science need scarcely arise in a course centred round economic products. Formal training could be given using the commodity under consideration as experimental material, while the human implications would inevitably be developed both in the classroom itself and by visits to local museums, botanic gardens and, where possible, to shops and stores which often display models and exhibitions depicting the derivation of their products from the raw materials. It might be argued by reactionary observers that this type of teaching would introduce too much of the utilitarian aspects of science and might even approximate towards totalitarian methods of imparting information. Further reflection, however, would show that this tendency is scarcely likely to develop even with those enthusiasts who are considered to be extremists in their method of propounding a more everyday outlook in their science teaching. Where knowledge is freely administered and where information is never withheld there also is the mainspring of freedom of thought ; and where the imparted information is made to link up with the problems of daily life, there, also, must be a better understanding and a more resolute confronting of our own difficulties and, equally important, those of our neighbours in other lands.

For the previous neglect in schools of the teaching of biological questions verging upon the economic, the universities must be held responsible in great part. The recruit to the school teaching profession attempts little during his first years except a repetition of factual material that he has assiduously collected in his Alma Mater. Although there are notable exceptions, in many of the universities little or no instruction is provided in economic biology even for students of honours degree standard. It is almost inevitable that this deficiency in the equipment of potential teachers must have an adverse effect upon the liberality of their early teaching at least. Even for students who are not contemplating entry to the teaching profession, the introduction of lecture courses and practical demonstrations relating to economic products would add both to the attractiveness of the syllabus and the usefulness of their training as a preparation for the rigours of modern life.

THE TAXONOMY OF TULIPA

The Genus Tulipa
By Sir A. Daniel Hall. Pp. viii+171+52 plates. (London: Royal Horticultural Society, 1940.) 21*s*.

THIS book on the genus Tulipa does not profess to be a monograph. The imperfection of the record makes a completely satisfactory monograph impossible at the present time, but the book must serve as such until many problems concerned with the tulip flora of Central Asia are solved by the collection of further living material. Sir Daniel Hall has devoted many years to the study and cultivation of the genus. While director of the John Innes Horticultural Institution and afterwards, he has been indefatigable in securing living material from every available centre. The genus presents very serious difficulties to the analyst. The number of criteria available for discrimination of the species is comparatively small, as happens often among the Monocotyledons. A second obstacle lies in the quality of herbarium material—even at the best affording inadequate evidence of the floral details. Consequently many species have been described on imperfect material which defies even the expert. Interpretation is also impeded by the excessive number of species described, the great majority of which are invalid. Accordingly Sir Daniel has restricted his review chiefly to those members of the genus which he has been able to grow in Great Britain.

If this book contained simply descriptions of the valid species it would perhaps appeal only to systematists and to keen growers of tulips. But the scope of the work is much wider than that. Apart from the workmanlike execution of the task, botanists, whether systematic or not, will be interested in Sir Daniel's methods of analysis. We hear a great deal in these days of the new systematics. Here in this volume we have a fine example of the new method and in a field well adapted for its exposition. It may be admitted forthwith that the ordinary macroscopic criteria would fail to disentangle the many systematic difficulties which occur in this perplexing genus. All the tulips which come under review have been subjected to genetical and cytological examination. The author, therefore, approaches this problem from several angles, and the genus itself proves to be one particularly suitable for such a combined attack. The various factors derived from more than one type of investigation are all happily blended. To the reviewer the chief pleasure has been not in the unravelling of a difficult series of plants but an appreciation of the methods employed by the author, for these he feels have a very wide significance and are bound to have a decided influence on future systematic work.

Adequate descriptions are given of all the species investigated, and of these certain ones can be picked out as eu-species, while the others must be relegated to subordinate positions. This is usually done by calling them subspecies, but in that case a trinomial term would be required. Such trinomials are never welcome to the horticulturist. Sir Daniel has not committed himself to the difficult task of proving that these subordinate species are really subspecies but has avoided the issue by calling them subsidiary species, by which action he is perhaps entitled to keep the binomial terms. The choice of the eu-species may lead to another problem. Certain species which are of older date and therefore hold priority are in some cases subordinated to species described later. It may well be that in certain cases the Procrustean rules of botanical nomenclature must be loosened.

It is recorded that the word 'tulip' itself has a comparatively recent origin and is, moreover, the result of an error. The earliest reference is in a letter by one Busbequius, who had specimens given him in Turkey and referred to them in a letter written in 1554. He says that the Turks call it 'tulipam' and cultivate flowers with extreme zeal. But the word used by the Persians and also by the Turks was 'lalé', and when Busbequius was presented with the flower he was told that it was very like a 'tulband' or 'turban'. Busbequius thought this was its name, wrote it 'tulipam' and so we have the word 'tulip'.

The origin of the race of garden tulips is still obscure, and the author does not find that the new methods throw much light on this long-standing problem. Evidently there is a considerable period of cultivation in Persia and Turkey behind these garden tulips, and no wild species can be indicated with any conviction as their progenitors.

Near the beginning of the text is a key to the species investigated. Except for the primary division into Eriostemones and Leiostemones, no further divisions are indicated. But in the body of the text certain apparently definite sections are mentioned in each of the two main groups. The key would be more workable if these sections could be incorporated.

The text itself, the forty coloured plates, as also the figures and line drawings, are of high standard. The passages on the history and distribution of the genus, on the general morphology with a wealth of observations on the living material, as well as on the pigmentation and cytology, eminently repay perusal.

W. WRIGHT SMITH.

ANTHROPOLOGY AND ADMINISTRATION

(1) Drama of Orokolo

The Social and Ceremonial Life of the Elema. By F. E. Williams. Pp. xxvi+464+62 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 30*s*. net.

(2) The Swazi

An Ethnographic Account of the Natives of the Swaziland Protectorate. By Brian Allan Marwick. Pp. xvii+320+8 plates. (Cambridge: At the University Press, 1940.) 18*s*. net.

(1) THIS book is dedicated to the late Sir Hubert Murray, fittingly enough. Not only does the author, the Government anthropologist of Papua, owe his existence, in an official sense, to that great administrator, but also the science of anthropology is indebted to him for his practical demonstration of its value in promoting the joint interests of people of different cultures and varied grades of civilization in the great administrative system which he built up by its aid in Papua in the course of more than thirty years of governorship.

The remarkable series of ceremonies of which this volume is a record is a striking example of the long and patient investigation which has been necessary before even the trained official has been able to arrive at a comprehensive view of the main integrating force in the social life of a group of people. The account of the *Hevehe* ceremony of the Elema peoples of Orokolo district on the Gulf division coast of Papua, forming the eighteenth in the series of anthropological reports published by the Government of Papua, embodies the results of eight working-periods totalling in all more than twenty-one months. How far so protracted an inquiry may be regarded as having contributed to, or have been an essential of, efficient administration to some may seem open to question. In the judgment of the anthropologist there can be no doubt.

It is, for example, to be noted that the great Vailala madness, the hysterical outburst which in 1919 and the succeeding years troubled the administration and led to the sacrifice of much of the more ornamental parts of Elema culture, though rampant in the adjacent regions, failed to touch Orokolo. The madness is attributed by Mr. Williams to the impact of a host of new ideas on a culture insufficiently stable to withstand them. In Orokolo the *Hevehe* ceremonial provided the stabilizing element which preserved its social organization from disintegration. In this connexion, however, the author makes some interesting comments on the functional element in social anthropology. He admits certain modifications in his earlier views on the effects of cultural change in the habits and outlook of peoples of backward civilization, which *mutatis mutandis* may be commended to the attention of those who are concerned with problems of cultural disintegration and their relation to administration in other parts of the world. Yet in noting the importance of pig culture in Papuan economy, virtually he allows the major contention that in cultural integration, certain elements are pivotal.

The ceremonial or cycle of ceremonies called *Hevehe* is carried through with much primitive magnificence. In fact, Mr. Williams says that it is "a finer thing than I imagined any Papuans could do". In its many stages it is a vast drama, of which the acts may spread over a period of so long as fifteen years. Until a quarter of a century ago it dominated the ceremonial and artistic life of the Elema people. It has now disappeared from the life of most of the Gulf villages, and even at Orokolo, the village in which the ceremony here described took place, features have dropped out.

Sorcery plays a great part in the Elema culture; and the religion is a species of combination of animism and cult of the dead. In the *Hevehe* ceremonial, however, it is the non-human spirits rather than the dead who are primarily affected.

The author divides his account of the Orokolo drama into three parts. In the first he provides a social and cultural background in a general description of the natural and social settings, a condensed monograph on the Elema peoples of 138 pages. In the second is an extended and detailed account of the *Hevehe* ceremony itself in all its stages; and finally, in a third part, is a critical study of the pragmatic value of the ceremonial. In this, as Prof. Seligman points out in his introduction, is "one outstanding remark, which has not perhaps been made so explicitly before", namely, that *Hevehe* rises high above everyday needs and provides active recreation which is so conspicuously absent in native life. It is this, Prof. Seligman points out, which W. H. R. Rivers had very much in mind when he spoke of the causes underlying the decay of Melanesian populations.

(2) For many years Swaziland has been 'news'. The long minority of the king, or paramount chief as he is now termed, and the strong individuality and astuteness of the queen mother which found abundant opportunity for exercise during her regency, frequently directed attention to anomalies latent in native institutions under white administration; while more recently, as one of the Protectorates affected by the proposed transfer to the Union of South Africa, the future of Swaziland has been under close examination and discussion.

Nevertheless, the people of Swaziland and their institutions have received comparatively little attention from the anthropologists; while the missionaries, having retained an even more strongly coloured view of native institutions than usual, have not, as elsewhere, provided any considerable store of information. Mr. Marwick, who has the advantage not only of some years experience as an administrative official, but also has spent some time in the field in intensive inquiry among native informants, has thus produced the first account of Swazi ethnography to approach anything like completeness. Since the close of his field-work, a research fellow of the International Institute of African Languages and Cultures has published a valuable study of the Swazi military organization, of which the main points are summarized in an appendix.

Swazi social organization, as is commonly found among the Bantu peoples of the southern region of the African continent, is of a highly complex character, closely interrelated as between its constituent elements. While following on broad lines what might be regarded as a general cultural pattern like other conformists to the general type, it exhibits innumerable local individualities and peculiarities which would make any attempt here at a summary account misleading. It is described with complete lucidity by the author. Among the people as a whole, the military system with its regimental organization is the predominant element, constituting a life-long bond—unfortunately now impaired by the necessity imposed on the younger men to meet taxation. On the spiritual side, however, the soul of the nation is embodied in the king or paramount chief, whose ritual character appears more especially in his function of rain-maker and in connexion with first-fruit ceremonies. This is not unfamiliar to students of the institutions of African kingship. More remarkable are the functions of the queen mother, who not only acts as regent during a minority of the king, but also even when he is paramount with full authority, has her own council and wields an influence scarcely if at all inferior to the authority of the chief.

Mr. Marwick dwells on the changes which have been introduced by the intrusion of white influence, especially the suppression of 'smelling out' witches by the administration and of polygamy by the missionary. In neither instance does he consider the changes beneficial. In native opinion the crimes witch-hunting kept in check have increased; monogamy has introduced or increased prostitution.

Experience as an administrator, whose knowledge of anthropology at first was purely academic but was vitalized by investigation in the field, has convinced Mr. Marwick that anthropology as applied to the institutions of the specific people affected is the most vital necessity in the equipment of an administrative official. Though he touches on this aspect of his work both as administrator and observer only briefly, his conclusions deserve the most careful consideration.

FAMILY ALLOWANCES

Population

Policies and Movements in Europe. By D. V. Glass. Pp. viii + 490. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 25*s*. net.

Mr. D. V. Glass is the research secretary of the Population Investigation Committee which was formed on the suggestion of Prof. A. M. Carr-Saunders, and has been partly financed by the Eugenics Society. He states in his preface that he does not deal with the question of planning, but has tried, by summarizing his work as research secretary, to give a general background against which we may set our ideas for the future.

The author begins by laying a useful foundation of population statistics, and notes the uselessness of crude birth-rates and death-rates for comparative purposes. For example, a crude death-rate of 11·9, in England and Wales, for 1930-32, by no means implies that the average age at death will be eighty-four. Actually, the expectation of life at birth, in those years, was 60·76, and this gives a 'life-table' death-rate of 16·46, which is the correct figure to take. He then explains the 'net reproduction-rate', after the method of Dr. Kuczynski, that is, the average number of girl babies that each newly born girl will have in the next generation. The first chapter ends with a reference to the estimates of the future population of England and Wales, as calculated by Dr. G. G. Leybourne (28·7 millions in 1976), and Dr. Enid Charles (31·4 millions in 1975)—on certain assumptions, which may well be falsified by the War. The population of England and Wales in April 1931 was almost exactly 40 millions.

In the second chapter we are given a historical summary of early population legislation, from the time of Augustus, including the laws of Trajan, who was responsible for "the earliest example of a family allowance fund". The last remaining vestiges of such ancient laws were swept away by Justinian in the sixth century. For more than a thousand years after this there are no definite population policies until we come to certain seventeenth century legislation in Spain and France.

Now we come to the core of the book, namely, population policies and family allowances in France, Belgium, Italy, Germany, and Scandinavia. For the rest of this review, we shall concentrate on the question of family allowances.

The author thus defines the term 'family allowance': "A cash grant, quite separate from, and in addition to, a man's wage or salary, given to help to cover the costs . . . of raising a family. . . . The grant generally varies . . . with the number of children, and is given only while the children are dependent."

Here we should note that there are two reasons for the introduction of a system of family allowances; first, the relief of poverty due to the expenses of a family; and, second, the arrest of the tendency towards depopulation.

We learn that the real beginning of the system was the scheme of E. Romanet, of a firm of engineers, at Grenoble, in 1916. Equalization funds were started in 1918, to avoid the result that employers might refuse to employ married men. Engineering firms were grouped together and each employer's contribution varied with the number of his workers and disregarded the number of married men, so that there was no incentive to discriminate against them. There were two kinds of funds, the professional and the regional. So much for the beginning. In 1932–33 and in 1936–37 the French Government introduced legislation by which all employers were ultimately to join equalization funds, in their region or industry.

Mr. Glass analyses for 1938 the position of French families with four dependent children, and finds that, in that year, "each child received an allowance equal to between 4·7 and 8·2 per cent of the basic earnings". In Belgium, in 1938, the average allowance for one child was 1·7 per cent of the basic earnings, rising to 17 per cent for a family of four children.

The author quotes an investigation by Prof. R. A. Fisher into the results of the equalization fund in Haut Rhin. There was, apparently, a slight success, but the material was not sufficiently detailed to justify a definite conclusion. Mr. Glass notes that family allowances would, at least, raise the level of nutrition and tend to lower mortality. He has made the approximate calculation that the increase necessary to maintain the standard of living of a working-class couple would be about 22 per cent of the basic wage per child. He shows that, in France, the family allowances were much below this level. He gives an account of the *Code de la Famille* of 1939, which allowed, in the case of an urban family, some 15 per cent per child. But France is now derelict, and all this is in the region of the might-have-been.

It may be as well to mention the views of a well-known worker in the same field, Mr. Fernand Boverat, who is sometimes referred to in this book. Mr. Boverat suggests the possible application of the principle to men serving with the forces, in the form of a reduction of the military obligations of fathers of large families.

The reviewer would like to note here an important scheme of family allowances which is in operation in Great Britain. Mr. L. J. Cadbury, in an address to the Liberal Summer School, at Cambridge in August 1939, said, "We have recently adopted a Family Allowance Scheme at Bournville. We employ between 10,000 and 11,000 people, about equally divided between men and women. An allowance of five shillings a week is paid for every child over two, where more than two are of school age. We have 410 children qualifying under the scheme". He remarked that investigation showed that the extra money was mainly spent on the children's food and clothing, and he made the interesting point that, since the introduction of the system, the attitude of the community has become more favourable to parenthood and the bringing up of larger families.

The chief reasons for the widespread custom of extreme family limitation are economic, and it is to combat these reasons that the system of family allowances has been devised. We may expect that, in the post-War world, some such general scheme will find its proper part in the reconstruction of society. Mr. Glass's book will serve admirably as a sound introduction to the study of this important matter.

PLANNING IN HUMAN SOCIETY

The Plans of Men

By Prof. Leonard W. Doob. (Published for the Institute of Human Relations.) Pp. xiii+411. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1940.) 18*s*. 6*d*. net.

PROF. DOOB, of Yale University, has in this volume attempted a comprehensive treatment of the subject of planning. It perhaps suffers from being too comprehensive, nearly half the book consisting of prolegomena in the shape of a general discussion of the main types of human activity, biological, social, political and economic. Prof. Doob also suffers from the common failure of sociologists to reconcile their conscience as pure scientists with a firm and constructive handling of the problem of values. In especial, no adequate attention is given to the question of the hierarchy of values—in fact, the author goes so far as to assert that "no man can say whether the gratification secured from beer is or is not different qualitatively from that obtained by reading a sonnet"—a statement which to the reviewer appears plain nonsense, on a par with saying that no one can say whether the sensation of red is qualitatively different from that of green.

In another place, in an effort to escape from his dilemma, Prof. Doob claims that to demonstrate a *qualitative* differentiation among gratifications is impossible unless one can prove that some are *more gratifying* than others (italics mine). But surely all attempts to interpret quality in terms of quantity are logically inadmissible?

Passing from criticism to appreciation, the reader can find much of interest in Prof. Doob's book. In the first place, he rightly stresses the fact that planning is not some mysterious new type of activity which has emerged since the War of 1914–18 as a product of the U.S.S.R. or the New Deal, but a universal attribute of all human activity, both individual and social. Its scope and the degree of its organization vary enormously, and the problem of the present is to determine, not whether planning in the abstract is or is not a good thing, but on what scale and by what machinery planning should operate. On this subject, Prof. Doob has some valuable comments. He is in general opposed to what he calls "master planning", in which an attempt is made to provide big plans for an entire social economy; and he produces a number of arguments for the adoption wherever possible of regional planning, as exemplified already in the Tennessee Valley Authority. This gives more flexibility and makes better provision for "cultural self-determination". (In this connexion, it is perhaps of interest to point out that Prof. Sewall Wright, of Chicago, has demonstrated that in biology the most favourable opportunity for evolutionary change is afforded by large species subdivided into subspecies which are partially but not wholly isolated from each other.)

"The Plans of Men" is perhaps not a book for the layman, however inquiring and intelligent: but it deserves serious study by sociologists and all those who may be concerned with the theory or practice of planning.

J. S. H.

PROGRESS IN BIOCHEMISTRY

Annual Review of Biochemistry

James Murray Luck, Editor; James H. C. Smith, Associate Editor. Vol. 9. Pp. ix+744. (Stanford University P.O., Calif.: Annual Reviews, Inc., 1940.) 5 dollars.

SCIENTIFIC workers cannot escape the welter of events, the horrors and anxieties of the moment. It is well, therefore, to be reminded occasionally that there is a normal side, that peaceful creative life exists. Such demonstration is welcome: it comes from across the Atlantic in the form of 743 pages of biochemical abstracts. True, the work described was done before war began, and the summaries, two of which are from Danish contributors, were written before April 1939. Everywhere there is progress, whilst some of the work will have practical application at a time when knowledge of food values and of much else in biochemistry will play a part in saving lives and in contributing to health in Great Britain.

Food is rationed. In twenty-five years the consideration of calories has given way to that of quality. The Minister of Food, acting under scientific advice, has the courage to tell the people that they must eat what is good for them and not what they individually fancy. Perhaps our national habits are about to be changed under scientific guidance. The work has been done in many laboratories; its interpretation has been the subject of much discussion and often controversy. Such problems have many angles, wide reading is required to appreciate them, and, since the number of papers has increased beyond our powers of study, summaries have become essential.

Murray Luck and his helpers realize that the pursuit of learning is in peril: it is for them in the Pacific and us in beleaguered Britain to prevent the eclipse.

Comment in detail on such a wide subject is more than usually difficult. It is of interest to read the statement that a protein is now being regarded by many workers as a pattern rather than as a thing—a molecule of definite composition but of dubious size. Analytical work is now once more considered of importance in establishing protein structure. The proteinase enzymes are regarded as consisting of two proteins at once.

Though viruses were discovered in 1892 it was not until 1935 that a tangible characteristic material carrying virus activity became available for biochemical study. They now form a fashionable subject for intense research, and a large number of general reviews, five books, and a new journal dealing with them have appeared during 1939. Another subject which is largely novel is insect biochemistry: here the biochemist is beginning to encounter many surprising phenomena.

The bulk of the essays bear well-known American names, but there are several British contributors, notably Heilbron and Jones, Channon, Raistrick, J. A. B. Smith, Dodds and Dickens.

E. F. ARMSTRONG.

INDIAN SPOROZOA

The Fauna of British India, including Ceylon and Burma

Protozoa: Sporozoa. By Dr. B. L. Bhatia. Pp. xx+498+2 plates. (London: Taylor and Francis, Ltd., 1938.) 30*s*.

THIS volume, dealing with the Sporozoa, is the author's second publication on the Protozoa in "The Fauna of British India", and follows the plan adopted in the preceding volume on the Ciliophora. Though a number of text-books on general protozoology have appeared in the last decade the treatment of the Sporozoa in them is very inadequate, while the more specialized publications devoted to the parasitic protozoa are already out of date. Dr. Bhatia has rendered a useful service by producing a comprehensive and modern work on the Sporozoa which, though limited to the description of those species which have been recorded from India and adjoining countries, will be of undoubted value to zoologists in all other parts of the world, since most of the genera belonging to this group have a cosmopolitan distribution. With the help of the keys provided, it should be possible to identify the genus of almost any sporozoon.

In the introduction the author reviews the position of the Sporozoa in the animal kingdom, their structure, phylogeny and classification. Lists are given of the parasites and their hosts, and vice versa, and there is a useful section on technique, dealing with the methods for the examination and study of these parasites. The greater part of the book is devoted to a systematic account of the Sporozoa. The description of each subdivision is accompanied by dichotomous keys for the identification of the lower units, down to genera and species. A separate description is given of each species recorded from India (total 320), usually with illustrations, and including the relevant references and synonyms. The classification adopted can be seen at a glance in the "Systematic Index" which contains the names of all the organisms recorded in the book, arranged in their systematic order. There is also a useful glossary of technical terms and an extensive bibliography occupying more than one hundred pages. The monograph is abundantly illustrated by text figures and by two coloured plates depicting human and simian malarial parasites.

There are several instances in which the nomenclature differs from that accepted by the majority of protozoologists (for example, *Laverania malariæ* for the parasite of malignant tertian malaria), but this is a controversial subject where difference of opinion is justifiable. Dr. Bhatia can be congratulated on the production of a book which will be of great assistance to zoologists—especially parasitologists and protozoologists, including medical and veterinary workers—in need of an authoritative and up-to-date guide to the systematics of the Sporozoa.

C. A. HOARE.

A Treatise on Quantitative Inorganic Analysis

With Special Reference to the Analysis of Clays, Silicates and Related Minerals. By Dr. J. W. Mellor and H. V. Thompson. Second edition, completely revised and re-set. Pp. xxxi+784. (London: Charles Griffin and Co., Ltd., 1938.) 45*s.* net.

In view of the excellent reception of the first edition of this book, it is surprising that so many years have been allowed to elapse before the issue of a second one. This was due, no doubt, to the many other calls on the time of the late Dr. Mellor, who finally entrusted to Mr. H. V. Thompson the task of producing a new edition. This task has been efficiently performed, the original text having been thoroughly revised and brought up to date by the incorporation of many of the newer methods and reagents introduced in recent times. Although written primarily from the point of view of analytical practice in the ceramic industry, the work covers practically all the elements and combinations of them which are met with in other analytical fields, so that it can rightly be regarded as a general treatise on quantitative analysis and one of great value to all who carry out complicated analyses.

The subject-matter is arranged according to the plan adopted in the earlier edition, being divided into five sections. These deal respectively with general analytical procedures, typical silicate analysis of glasses, glazes, colours and complex silicates, special methods including procedures for many of the rarer metals and, finally, the analysis of acids and non-metals. All these are treated in a most detailed and thorough manner, while additional information is often given in footnotes which also contain an excellent and wide selection of references from the literature. Those who have used the first edition will need no recommendation to this revised work, while those who have not, will find it one of the best text-books on its subject.

Rural Community Organization

By Prof. Dwight Sanderson and Prof. Robert A. Polson. Pp. ix+448. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 18*s.* net.

This book is a contribution to the solution of the old question whether man can control his social relations by taking thought as he does control the world of things. Organization of social relations must be based on an understanding of the facts. The authors state that to aim at organizing a rural community in a mechanical way such as is implied in 'social engineering' is vain, and they assert that "rural social organization is the art of planning social relationships in the rural environment by use of the methods of science". They do not, however, give more than passing reference to possible scientific methods of approach to the problems they discuss: the science they have in mind is the rather vague one of sociology, and it appears as if they had no conception of the possibilities of modern statistical reasoning. The book is an able exposition of applied psychology, illustrated with many well-documented examples of what has been done in the field of rural community organization in the United States. However empirically this has been performed, it is a beginning which offers useful lessons and can be developed. The chapter analysing community conflict and clashes of interest is novel and is particularly trenchant. The book presupposes that the student will have had a course in general sociology or rural sociology, but this is said not to be essential for mature students who have had personal experience in rural life.

Food Control, its Public-Health Aspects

A Manual for Regulatory Officers, Food Technologists and Students of the Food Industry. By Dr. James Houston Shrader. Pp. ix+513. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s.* net.

Although Dr. Shrader's volume is written primarily for the American reader and is concerned mainly with United States public health administration, it will be welcomed by many in Great Britain as a valuable and concise manual. The author surveys a very wide field and, on the whole, does so with commendable balance and sense of proportion. In most respects his treatment is up to date. This is particularly true of his descriptions of the technical side of food preparation and manufacture. By contrast one comes now and again to sections where his knowledge is curiously behind what we should expect. Thus, for example, although compiled in the early part of last year, the section on the vitamins is far from adequate. There is merely passing reference to nicotinic acid, B_6 is not mentioned, and attention is not directed to the important differentiation between D_2 and D_3. However, any small disappointment these minor faults may provoke is soon dispelled by appreciation of the merits of the book as a whole. They are many and they far outweigh the defects, not the least of which is the use of dreadful terms such as 'organoleptic acceptance'. Shall we live to see a hoarding bearing the slogan 'Guinness is organoleptically acceptable'?

J. C. D.

Human Histology

A Guide for Medical Students. By Dr. E. R. A. Cooper. Pp. xiv+424. (London: H. K. Lewis and Co., Ltd., 1939.) 16*s.* net.

Dr. E. R. A. Cooper, lecturer in histology at the University of Manchester, whose work is introduced by Prof. F. Wood Jones, the professor of anatomy, is to be warmly congratulated on the production of a text-book which will be of the utmost value to the medical student and graduate both in the laboratory and in the study. The volume, which is clearly and concisely written, consists of twenty-one chapters dealing with the microscopic anatomy of the various systems and organs. A remarkable and praiseworthy feature is the insertion at the end of each chapter of a practical examination to be carried out by the reader.

The text is liberally interspersed with microphotographs, and an excellent index is supplied.

Modern Physical Laboratory Practice

By Prof. John Strong, in collaboration with Prof. H. Victor Neher, Prof. Albert E. Whitford, Dr. C. Hawley Cartwright, and Roger Hayward. Pp. x+642. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 25*s*. net.

UNTIL recently, when the physicist wanted a good advanced book on a branch of the subject, he expected to find it in a bibliography of German books. Now he is far more likely to find what he wants in an American publication. The present volume is a striking example. Three physicists, an astronomer and an architect have collaborated to produce a guide of outstanding excellence to the many special techniques now apt to be needed in the advanced or research laboratory. Two chapters at the end of the book deal with moulding, casting, and various workshop operations in metals, together with instrument design, including kinematical design. The rest of the book covers glass-blowing, optical work of all kinds, from grinding to surface coating, high-vacuum technique and such electrical instruments as electrometers, electroscopes, Geiger counters, photo-electric cells, amplifiers, and vacuum thermopiles.

The chapter on photography is a good example of the skill of the authors in giving briefly enough of the theory of an operation to enable the worker to adapt the instructions to his special needs.

Quite outstanding are the diagrams drawn by the architect collaborator, Roger Hayward. Several hundreds consist of perspective drawings with just the right amount of shading to give a pictorial effect. This, together with arrows and concise wording on the actual diagrams, gives the next best substitute for seeing the operations carried out. These diagrams deserve the serious attention of every future illustrator of physics text-books. The strict biological accuracy of including the sweat on the brow of the operator in grinding a 6-inch mirror by hand in the traditional way, adds a touch of humour, as well as giving a subtle warning.

Altogether, the book can be strongly recommended to the attention of all physicists. Several copies kept always at hand would help the work of any large group of physicists who, in times like the present, may be working at high pressure with semi-skilled assistants. W. H. G.

Penobscot Man

The Life-History of a Forest Tribe in Maine. By Prof. Frank G. Speck. Pp. xx+325. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1940.) 24*s*. net.

IT is a matter of frequent remark that in the last ten or fifteen years few if any of the sciences have made more rapid strides than anthropology in the development of methods of inquiry. This applies in particular to researches in social anthropology in the field and no less to the United States than to Great Britain, notwithstanding the differences in aim and outlook which mark the leading schools of thought in the Old World and the New. It is instructive to consider from this point of view the material recorded in a study of the Penobscot, an Algonquian Indian people of the State of Maine, by Prof. F. Speck, whose record of the little-known Naskapi of Labrador aroused no little favourable interest when published a few years ago.

Prof. Speck's observations of the Penobscot began in 1907, were continued until 1912, and resumed in 1918, and his record prepared from then onward. As he recognizes, observations on the lines of modern method would have produced a study of a very different character. Yet his work rounds off an epoch in the development of the Indian tribesmen. When he saw them much of their traditional culture remained unchanged from perhaps so far back as colonial days, when the British administration declared them outlaws and in 1756 was offering so high a price as £300 for an Indian scalp. So great has been the change in the interval since the date of Prof. Speck's investigations, that a student of the Penobscot nowadays would be constrained to make his investigation one of acculturation. Incidentally it may be mentioned that the Penobscot who enjoy an independent system of local administration of their own in the State of Maine and for whom ultimate extinction was prophesied a generation ago, like a number of other Indian tribes, have actually increased in numbers and there are now more than five hundred members in the tribe. They are, however, much mixed in blood.

Strength of Materials

By Dr. Arthur Morley. Ninth edition. Pp. x+571. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15*s*. net.

THE late Sir George Greenhill, referring to Rankine's paper on the screw propeller, described it as a classic, adding, "which means something that is seldom read". This cynicism could scarcely apply to the work before us, now in its ninth edition totalling 52,000 copies. But if we accept the Oxford Dictionary as an authority we find Dr. Morley's book admirably qualified as "simple, harmonious, proportioned, and finished".

The first edition, reviewed with pleasure by the present writer thirty-two years ago, marked a distinct advance in engineering literature, and despite the progress in materials since then the book is remarkably modern. This is due to the candid style, rational outlook and clear planning of the original edition; an excellent tree on which shoots could be grafted. Although the book is a students' manual with 'exercises' to each chapter, it is also a lucid, accurate and handy work of reference and refreshment for the practitioner. The specialist may find here and there that the latest work has not been fully embodied into the text, but usually he will see a useful reference in a footnote. In later editions more complete treatment of ideas now fermenting may be possible; plasticity, auto-frettage, notch sensitivity, fretting, damping, and the effects of surface polish and machining stresses. The new plastics and the use of models in plaster and rubber may be added. In any event the book has still a useful future. H. S. R.

COCARBOXYLASE

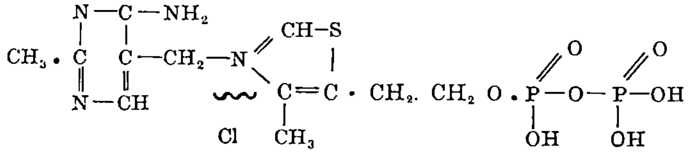
By Prof. R. A. Peters, F.R.S.,
University of Oxford

KNOWLEDGE of the detailed action of vitamin B_1 in Nature has advanced farther than in the case of any other vitamins with the possible exception of riboflavin, and nicotinic acid; even in the case of these, detailed knowledge has come to hand more recently. This is not only due to the striking advances in the pure chemistry but also to the fortunate circumstance that it was the first vitamin in which specific action *in vitro* upon an animal tissue was demonstrated[1]. Since its action is so intimately bound up with a fundamental stage in the degradation of carbohydrate, it justifies in a way the conception originally lying behind the use of the word 'vitamine' by Funk. Useful as the new terms for this vitamin 'aneurin' and 'thiamin' undoubtedly are, it seems a pity to lose sight of the idea of the "amine essential for life", because in a way this is very nearly true. Formation of carbon dioxide depends more upon this factor than upon any other.

In 1912, Neuberg and Kerb reported the presence in yeast of an enzyme called carboxylase, which catalysed the decarboxylation of α-keto acids according to the equation

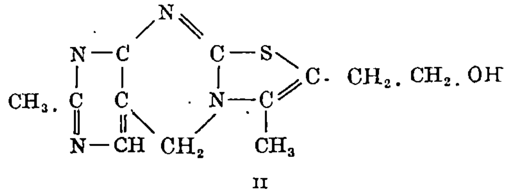
$$R.CO.COOH = R.CHO + CO_2$$

where R is a simple aliphatic radicle. Auhagen (1932), working in von Euler's laboratory, split carboxylase into two factors, both needed for activity, a protein one and a thermostable factor known as cocarboxylase. There had been a previous claim (1928) that there was a form of vitamin B_1 precipitable by lead acetate[2]. In 1936, Lohmann and Schuster, in a now classical paper, isolated cocarboxylase as a crystalline compound, and proved that it was the pyrophosphate of this vitamin (I).



I

Short hydrolysis (7′) in *N* hydrochloric acid converts cocarboxylase to vitamin B_1 monophosphate, an inactive compound. Owing to esterification upon the —OH group of the thiazole ring, cocarboxylase does not give the formaldehyde azo reaction of aneurin, though it still reacts with alkaline ferricyanide to form the brilliant blue fluorescent 'thiochrome' ring (II), giving thiochrome pyrophosphate; this can be distinguished from free thiochrome (though not from thiochrome-monophosphate) by its failure to pass from an alkaline solution into a butyl alcohol layer, a property which can be used in estimation. Digestion with takaphosphatase and pepsin can be used to convert phospho forms to free vitamin for estimation as thiochrome[3]. In milk especially the cocarboxylase is more firmly bound to the protein present, being not freed as in yeast by boiling, so that a predigestion is essential for accurate estimates of total vitamin B[3a]. An earlier and usual method of estimation makes use of the carbon dioxide production from pyruvic acid over periods varying from 30 sec. to 2 hr. In this a yeast preparation, usually known as ætiozymase freed from cocarboxylase by washing under alkaline conditions, is treated with pyruvic acid, when the extent of carbon dioxide production is determined by the amount of cocarboxylase added; Mg or Mn″ must be present. Accumulating acetaldehyde brings the reaction gradually to a stop; Zn and Cu ions are inhibitory. Doubt was cast upon some earlier results reached by this method, when it was found by Ochoa in 1937 that free vitamin much stimulates carbon dioxide production with a given amount of cocarboxylase when no synthesis to cocarboxylase could be detected. This effect, due to the pyrimidine half of the molecule, was so regular that it could be used by Ochoa and Peters as a means of estimating separately both vitamin B_1 and cocarboxylase in a boiled tissue extract. In spite of this regularity others, notably Lipton and Elvehjem, and Weil-Malherbe, have obtained ætiozymase preparations which show no 'Ochoa' effect. The explanation of this puzzle, at any rate in part, is due to Westenbrink and van Dorp (1940). The addition of B_1 (or the pyrimidine) inhibits



II

the action of a phosphatase, which if present breaks down the added cocarboxylase. So the effect is an artefact, a conclusion which Oxford workers had reached owing to failure to see it with animal tissues. Still the inhibiting action upon phosphatase may be more important than we know. (There is yet unexplained why Lipton and Elvehjem should get less activation with fresh yeast, where one would expect the presence of more active phosphatase.)

Cocarboxylase has been synthesized by chemical methods using heating of vitamin B_1 with pyrophosphoric acid[4] or by treatment of the halogen compound along the lines of the equation[4].

$$C_5H_6N_3{-}CH_2{-}C_4H_4NS{-}CH_2CH_2Br + AgH_3P_2O_7 = C_5H_6N_3 - CH_2 - C_4H_4NS - CH_2CH_2OP_2O_6H_3 + AgBr.$$

The yields are spoilt to some extent by the difficulty of separating the monophospho B_1 formed[4].

Since cocarboxylase is an essential factor in the final stage by which acetaldehyde is formed, it is clear that it is also essential in the formation of alcohol. There have been several problems in the minds of workers in this field. Is the vitamin in the animal tissue, as in the yeast cell, only active in the pyrophosphorylated form ? This was what Lohmann and Schuster thought, though did not really prove. What is the distribution of the factor ? How is it synthesized by animals and yeast ? With these questions is bound up the interesting problem of exactly what the vitamin does in the body in its relation to the metabolism of pyruvic acid.

Normal animal tissues contain cocarboxylase in larger, much larger, amounts than free vitamin. After injection or feeding of vitamin B_1 especially with avitaminous animals there is a large increase of cocarboxylase in the liver, showing the marked capacity for synthesis possessed by this tissue, which is shared by kidney[5]. The predominance of the phosphorylated form was certainly in favour of the view that this was the active form, though this has only recently been put beyond all reasonable doubt. Banga, Ochoa and Peters[6] have succeeded in an apparently final proof using the avitaminous animal with symptoms as the crucial test. Very briefly, the facts are as follows : normal pigeons contain 4 μ gm./gm. of cocarboxylase, avitaminous in symptoms, 0·4 μ gm./gm., 'rice fed' animals but not in symptoms, about 1·2 μ gm./gm. The loss of some 0·8 μgm. is enough to precipitate the symptoms. With brain brei from an avitaminous bird, the catatorulin effect of vitamin B_1 (extra oxygen uptake due to addition of vitamin, pyruvate as substrate) is greater than that of cocarboxylase. This formed a stumbling block to a final proof, because the action of cocarboxylase should have been at least equally great. Using two types of finely ground brain preparations (dispersions), it was found that with the most macerated of these only cocarboxylase stimulates oxygen uptake ; with an intermediate type both vitamin B_1 and cocarboxylase are active, but in the reverse order to the brei. Further there was a small but sufficient synthesis both in brei and also in dispersions, where stimulation with vitamin was observed. So it is clear that failure of cocarboxylase to give good catatorulin effects with brei was due to lack of penetration of the phosphoester to the active centre, as had been previously suspected. These new facts seem to settle finally that the form responsible for normal brain activity is cocarboxylase, and give a good idea as to what happens to the vitamin after administration. Sinclair and Goodhart have found cocarboxylase present in blood corpuscles, especially when nucleated, but there are small amounts of free vitamin in plasma. So we can conclude that though liver and kidney trap aneurin as cocarboxylase, it is carried free as wanted in the blood and synthesized to the pyrophosphate after passage through the cell membrane. The brain enzyme system is saturated with about 1 μgm., cocarboxylase per gm. of fresh brain. Under optimal conditions, 1 mol. of cocarboxylase will catalyse the uptake of 1,500 mol. oxygen per minute.

Synthesis of cocarboxylase by yeast and animal extracts has been studied. Kinnersley and Peters were actually the first to record that fresh baker's yeast readily formed this from free vitamin under simple conditions ; it was separated by lead acetate ; a little later Euler and Vestin claimed a conversion with dried yeast upon not very substantial evidence. In 1938, Lipschitz (now Lipton), Potter and Elvehjem made the claim that cocarboxylase was synthesized by an ætiozymase preparation in their possession. It was based upon the finding that (*a*) vitamin B_1 stimulated the carbon dioxide output in presence of magnesium, pyruvate and boiled tissue extract, and (*b*) that hexosediphosphate increased this decarboxylation, again in presence of boiled tissue extract. In view of the 'Ochoa' effect, (*a*) alone cannot prove this. In considering (*b*) a general principle is involved. It is always safer to have a direct estimate of the amount of cocarboxylase present rather than an inference from increased carbon dioxide outputs. When it was found at Oxford that hexosediphosphate alone increased the carbon dioxide output in complete absence of vitamin provided that both pure cocarboxylase and cozymase were present, an alternative explanation became available. By dismutation of triosephosphates (formed from hexosediphosphate) with acetaldehyde in presence of cozymase, ethyl alcohol and phosphoglyceric acid would be formed; thus the concentration of acetaldehyde would be reduced, which is known to inhibit carbon dioxide output in this system. Another factor involved is the stability of the cocarboxylase, which is destroyed by phosphatase, but continually resynthesized and so maintained at its constant level in presence of cozymase and carbohydrate[7]. Though these experiments did not provide the necessary proof of synthesis, later work by the same authors and by Weil-Malherbe has done so.

Before considering this, we may turn to the animal, where positive results for synthesis reported by Euler and Vestin for rat liver extracts and for avitaminous brain by Peters were invalidated by ignorance of the 'Ochoa effect'. Tauber's claim for synthesis by acetone preparations of intestinal mucosa also could not be confirmed by Ochoa except under conditions where growth of bacteria was possible. Likewise Stern and Hofer failed with glycerol extracts of various tissues. On the other hand Lohmann and Schuster had originally reported a well-controlled synthesis with brain under alkaline conditions, which was finally confirmed for biological *p*H in the work already mentioned. Synthesis *in vitro* with liver has been studied by Ochoa using the avitaminous pigeon, because the amount found in the normal is near the limit for synthesis. Liver slices, brei or dispersions showed a similar degree of activity, extracts less, and acetone-dried preparations none. Quadrupling the vitamin at amounts near the maximum did not increase synthesis, so that the percentage conversion is larger for smaller amounts. The synthetic reaction occurs from *p*H 6·2 to 10 (optimum *p*H 8·5), and is dependent upon the presence of an intact oxygen uptake or respiration; it was not improved by addition of adenosine triphosphate, phosphoglyceric acid, glucose or sodium hexosediphosphate, and was much more inhibited by iodoacetate (0·009 *M*) than by sodium fluoride (0·04 *M*). A point of importance was the proof that the tissues contained a soluble enzyme, which would destroy cocarboxylase anærobically, in amounts parallel to the ærobic synthetic activity, which led to the inference that in respiring systems there is continual resynthesis. Ochoa thinks that one and the same enzyme catalyses the reaction vitamin B_1 pyrophosphate $\rightleftarrows$ vitamin B_1 + 2 phosphate, the energy from respiration being required to shift the equilibrium in this reaction to the left. Recently, Goodhart and Sinclair (1939) have achieved synthesis of cocarboxylase with nucleated blood cells.

Returning now to synthetic work with yeast, both Lipton and Elvehjem and Weil-Malherbe[8] have recently formed cocarboxylase with ætiozymase from brewer's bottom beer yeast under conditions now quite convincing, because either (1) the preparations show no B_1 stimulation or (2) interpretation has not depended solely upon increased carbon dioxide production. As with liver, the degree of synthesis is determined by saturation of the protein component of the enzyme. Upon addition of free vitamin, Weil-Malherbe finds an induction period of 15 min.; the synthesis is much stimulated by adenosine triphosphate. Phosphopyruvic acid is decomposed if there are simultaneously present vitamin B_1, a phosphate carrier (adenosine triphosphate), and an acceptor such as glucose. Differing somewhat in detail, the others reach the same general conclusion that phosphorylation is induced by adenosine triphosphate, this being connected with various stages of the Embden-Meyerhof cycle, much as would be expected from the previous work of Meyerhof and D. M. Needham. There are several points of interest in this work lying outside the scope of this review.

The course of the reactions with yeast appear comparatively simple; cocarboxylase and a protein factor together catalyse production of acetaldehyde and carbon dioxide from pyruvate. In the animal it is more complicated; acetaldehyde never appears. In brain tissue, the course of oxidation of pyruvate is represented by the following three simultaneous equations in the proportions indicated:

19·5 per cent $2CH_3.CO.COOH + O_2 = 2CH_3.COOH + 2CO_2$ . . . (1)

67 per cent $2CH_3.CO.COOH + 5O_2 = 6CO_2 + 4H_2O$ (2)

10 per cent $2CH_3.CO.COOH + H_2O = CH_3.CHOH.COOH + CH_3.COOH + CO_2$. (3)

This is known from quantitative data by Long upon acetic and lactic acids and by McGowan upon oxygen/pyruvate ratios and respiratory quotient, (CO_2/O_2). The Krebs dismutation equation 3 need not concern us further, except to point out that Barron and Lyman have now proved that this reaction is separate from that of equation 1. Reactions 1 and 2 required simultaneous decarboxylation and oxidation, and the exact nature of the systems involved has given rise to much work. What enzymes are needed for the complete oxidation? Are the reactions of 1 and 2 separate or is 2 conditional in part upon 1? What is the course of pyruvate oxidation? What is the biological object of pyruvate oxidation?

Reaction 1 is carried out anærobically by washed brain tissue in presence of methylene blue. Lipmann has studied a simple example of this in more stable acetone dried lactic acid bacteria preparations; he has found the following essential, cocarboxylase, Mn″ or Mg, a protein and inorganic phosphate, also the adenine flavin dinucleotide[8]. He considers now that acetyl phosphate is an intermediate in acetic acid formation, being formed oxidatively as in the equation

$$CH_3CO.COOH + H_3PO_4 + O_2 = CH_3COO.PO_3H_2 + CO_2 + H_2O_2$$

When added to the bacterial preparations (with pyruvate), adenylic acid was phosphorylated to adenosine triphosphate, without increase in pyruvate dehydrogenation. Ochoa, Stocken and Peters could not find that acetyl phosphate behaved as an intermediate in brain reaction 1, which is known to need inorganic phosphate. But Banga *et al.*, in the last eighteen months, using dialysed dispersions, have proved that for reaction 2 there are wanted in addition to the above, fumaric acid (the Szent-Gyorgyi C_4 catalytic system ; this system involves the acids succinic fumaric, malic, and oxaloacetate, the enzymes succinic and malic dehydrogenase and fumarate), cozymase (probably) and adenylic acid. The function of the latter differs from that in Lipmann's experiments in the sense that the oxidative removal of pyruvate is greatly increased in its presence. So there is proof for the first time that the 'adenine nucleotide' is needed for respiration and oxidation of pyruvate in animal tissues ; both oxygen is taken up and carbon dioxide evolved in the completed system. For this important and to some extent final step in metabolism, brain cells mobilize a complex of their enzymes.

Earlier work suggested that in brain an unknown intermediate from reaction 1 could either be oxidized along the lines of equation 2 or, in absence of some factor in the complete oxidation system, be merely degraded to acetic acid ; in other words, reaction 2 is bound up with reaction 1. This was supported by quantitative evidence from the behaviour of α-keto butyric acid, which, though disappearing at the same rate as pyruvate, is merely degraded to proprionic acid. More recent unpublished work[9] suggests that the matter is not quite so simple, so that the question must still be considered an open one as to whether reactions 1 or 2 are related or not. The course of oxidation in reaction 2 is not yet clear. Obviously this would be well realized if C_2 fragments in phosphorylated or other form (due to decarboxylation) were resynthesized to carbohydrate, afterwards to be degraded upon the usual lines. But though it is known that phosphoglycerate will re-enter the system in dispersion, the poor oxygen uptake given by hexosediphosphate with the dispersion is much against this attractive view. Turning to the possibility that oxidation may take place either through the C_4 acids or through some combination of these and citrate, a very complete scheme has now been produced by Krebs and colleagues[10] for muscle. This must be distinguished from the idea that these acids act catalytically. It can be said that citrate alone will not replace fumarate in catalytic action upon pyruvate oxidation in brain dispersions, showing that it is not readily convertible to this in the dispersion ; also, the rate of oxidation with brain of α-keto glutarate ($COOH.CO.CH_2CH_2$-$COOH$) suggested as intermediary seems too slow to satisfy conditions as an intermediary ; hence for the moment the balance of evidence seems against the idea that the citrate cycle is directly involved in brain. Experiments in this field are complicated, however, by the ease with which oxaloacetate ($COOH.CO.CH_2COOH$) formed from fumarate via malate can pass back to pyruvate ; there is no doubt that some cycle involving this decarboxylative return to pyruvic acid with loss of carbon dioxide is attractive ; but whatever scheme is involved, it does not seem possible to dispense with some C_2 fragment as at any rate part of the oxidation, and therefore with cocarboxylase.

Considering the function, it seems clear now from recent work by Ochoa[11] that under suitable conditions oxidation of pyruvate in presence of adenylic acid can cause phosphorylation of both hexosemonophosphate and also most interestingly of glucose itself, 'adenine nucleotide' being the intermediary carrier of phosphate. (Cori, Colowick and Cori[12] have shown that in kidney, synthesis of phospho esters from glucose is coupled with succinate oxidation, following up work by Kalckar[12].) This phosphorylation of glucose by a dialysed brain dispersion with appropriate additions in presence of fluoride is an achievement of no small significance, not least because of the claims for the existence of non-phosphorylating glucolysis in brain. It may be emphasized that this step only takes place ærobically so far as it is produced by pyruvate oxidation, and so far as our present knowledge goes ; of course there can take place anærobically transfer of phosphorus from phosphopyruvic acid via the adenylic acid system. It will be fascinating when we can say exactly how the phosphate is transferred to adenylic acid during pyruvate oxidation, but meanwhile the main object of the oxidation appears to lie in the maintenance of mobile phosphate.

Finally we come to the question of the mechanism of decarboxylation (yeast) and decarboxylation-dehydrogenation (animal and *B. delbruckii*). There has been no lack of speculation upon this, both in print and out of it, and much play with various models. It has often been suggested that decarboxylation occurs through combination of the keto group of pyruvate with the $-NH_2$ group on the pyrimidine molecule upon the lines of Langenbeck's much quoted scheme. Likewise

Weil-Malherbe has directed our attention to the familiar scheme of Martius and Knoop for transamination, and indicated a way in which (on paper) we may get the desired decarboxylation and dehydrogenation. Unfortunately the acetyl cocarboxylase required to implement the hypothesis is missing. Lipmann has the idea that hydrogen can be added to the quaternary group as in cozymase, and has been able to get a stable reduced thiazole product with benzthiazole ; unfortunately the reduction product of cocarboxylase is unstable, so that we have not yet proof from this work that reversible oxidation and reduction can occur ; but Stern has recently joined with the statement that though free vitamin can be broken down by hydrogenation with platinum black, cocarboxylase is reduced to a compound which is still active. In a repetition of these experiments Ochoa (personal communication) finds that the rate of hydrogenation of either, with platinum black or hydrosulphite, is much slower than that of cozymase ; in view of this slowness, the claim does not carry conviction. Considering the large amount of thought given to the details of this reaction, it is quite extraordinary how it still stands up to investigation ; this is shown by the battered fragments of research which finally see the light ! Probably we must first know more about the protein component, which is likely to alter the reactions of the molecule. Nevertheless the challenge as well as the interest remains, and we can at least say that we know much better now why vitamin B_1 is important.

(I am much indebted to Dr. Ochoa for helpful criticisms.)

[1] Gavrilescu, Meikeljohn, Passmore and Peters, *Proc. Roy. Soc.*, B, 110, 431 (1932).

[2] Kinnersley and Peters, *Biochem. J.*, 22, 419 (1928).

[3] See especially Pyke, *J. Soc. Chem. and Ind.*, 58, 338 (1939).

[3a] Houston, Kon and Thompson, *Soc. Chem. and Ind.*, *Proc. Biochem. Soc.*, July 1939.

[4] Weijland and Tauber, *J. Amer. Chem. Soc.*, 60, 2263 (1938); Weil-Malherbe, *Biochem. J.*, 34, 980 (1940). Stocken (unpublished).

[5] For many references see recent lecture, *J. Soc. Chem. and Ind.*, 59, 373 (1940).

[6] Banga, Ochoa and Peters, *Biochem. J.*, 33, 1109 and 1980 (1939).

[7] Ochoa (unpublished).

[8] Lipton and Elvehjem, also Lipmann-Sympos. Quant. Biology Cold Spring Harbor (1940); Weil-Malherbe, *Biochem. J.*, 33, 1997 (1940).

[9] Ochoa and Long (independently); unpublished.

[10] Krebs and Eggleston, *Biochem. J.*, 34, 442 (1940).

[11] Ochoa, NATURE, 146, 267 (1940).

[12] Cori, Colowick and Cori, *J. Biol. Chem.*, 133, 359 (1940).

THE RATE OF A MOVING CLOCK

By Prof. Herbert Dingle,

Imperial College of Science and Technology

In an earlier article[1] it was pointed out that there is no foundation for the oft-repeated and generally believed statement that the rate of a moving clock is reduced by a certain factor compared with that of a similar stationary clock. The statement is baseless because in physics there is no explicit definition of a clock. A time-scale only is prescribed, and any instrument which records intervals agreeing therewith can legitimately be used as a clock. Three examples of such instruments were chosen, and it was shown that in no two of them was the ratio of the rates of stationary and moving clocks the same. It follows that, for any particular type of clock, this ratio (which, however, has no fundamental importance) can be determined only by taking into account the principle or the mechanism by which the clock operates. The familiar relativity transformation, $dt' = dt/\sqrt{1 - v^2/c^2}$, refers to the *time-scale* of physics, and can be logically deduced from the experimentally determined effect of motion on space measurement because the time-scale itself is defined in terms of space measurement : it is quite independent of the behaviour of moving clocks.

This article has given rise to a mass of correspondence, a small fraction of which has been published in NATURE. Almost every correspondent has dissented from the conclusion summarized above, and as the objections have mainly been based on the same few considerations, it seems desirable to make a further attempt to elucidate the question by discussing them specifically. It will be sufficient to limit attention to two of the three sample clocks chosen, which we may call a 'mass-clock' and a 'volume-clock', respectively. It may be remembered that these were instruments of hour-glass type, in which drops of water fell into a receptacle, and the time-interval from a given zero was defined to be proportional in one case to the mass, and in the other to the volume, of water which had fallen. The instruments were presumed to have been adjusted at an observatory so that their rates when at rest both agreed with the mean solar time scale. It then follows that, since the transformation formulæ for mass and volume are different, the rates of the clocks when in motion must be different also.

One complication, which most correspondents have introduced, should be excluded at the outset : the problem has nothing to do with the comparison of observations by different observers. One observer only is involved, and it is his business

---

to compare the rates of two similar clocks, one at rest and the other moving uniformly with respect to him. Anyone, therefore, who has "disproved" the thesis of the article by invoking the findings of a second observer will be well advised to simplify his argument by eliminating this superfluous being. A second observer can, of course, be admitted as an auxiliary, provided that the argument can, in essentials, survive his withdrawal. When, as in all the instances I have so far seen, it cannot, it is clear that the argument is beside the point.

The commonest example of this confusion is found in the contention that the mass-clock and volume-clock are legitimate instruments, provided that their readings are taken by observers moving with them instead of by the observer standing by the 'stationary' clock. It is difficult to see any justification for this arbitrarily imposed condition, but let us see what it becomes when the auxiliary moving observer is removed. The condition then is that the time-interval must be defined as proportional, not to the mass or volume of fallen water, but to the rest-mass and rest-volume respectively. I have no quarrel with this as a definition of other types of clock, though it is open to the objection, so far as our present problem is concerned, that a 'moving' clock is by definition an impossibility, and the problem is therefore unapproachable. What I find difficult to understand, however, is why the inventors of these clocks think that they will exhibit the relativity transformation of the time-interval, dt. Rest-mass and rest-volume are, of course, invariant to uniform motion, and the transformation formula is therefore $dt' = dt$. This simply reinforces my point by giving additional variety to the behaviour of moving clocks.

A large number of correspondents seek to throw light on the matter by examining the process of observing the dial of the moving clock. The passage of light to the observer, and the effect on the time of its arrival of the motion of the clock, are discussed in detail—always, of course, with the standard relativity transformation formula emerging triumphantly at the end. These considerations are very interesting and instructive ; their defect is simply that they have nothing to do with the point under discussion. This might have been guessed from the fact that the principles underlying them were well understood before the theory of relativity was thought of, and if they could have yielded a transformation formula differing from the classical one, that fact would have been discovered long ago. It may be worth while, however, to show their irrelevance by presenting a condensed form of the argument concerning the mass- and volume-clocks. Let two mass-clocks and two volume-clocks be adjusted so that in the former 1 gm. and in the latter 1 c.c. of water falls in each mean solar second when all are at rest. The four clocks then run at the same rate when there is no relative motion between them. Now let the observer stand by a mass-clock and a volume-clock, and let the other mass-clock and volume-clock move away from him, side by side, at uniform velocity. The process of observing the moving clocks will then be the same for both but, since density is not invariant, 1 gm. of water will not fall in the same interval of time as 1 c.c. The two moving clocks therefore run at different rates, and there is no difference in the process by which they are observed to account for their disagreement.

The objection that a clock must not be defined by a principle (such as that time interval is proportional to mass of fallen water) but is simply a piece of matter the dial readings of which must be accepted without correction has already been dealt with[2]. Anyone who holds this view must explain why the measurement of time differs radically from that of temperature, pressure, etc., and must state, and justify his statement, which of the many varieties of 'clock' is the one which must be used in an experiment to test the rates of moving clocks. Having done this, he must explain why we know the transformation formula for dt although experiments on this unique clock have not been made, and he must further consider what, in the event of such experiments being made and yielding an unexpected result, he would do about it. These duties not having yet been performed, we are justified in accepting as a clock any instrument defined and constructed in such a way that its readings, so long as it obeys the definition and preserves the construction, are passed by a recognized observatory as a true record of the standard time-scale.

It seems, therefore, impossible to avoid the conclusion that if one sets in motion any instrument normally accepted as a clock, and compares its rate with that of a similar instrument at rest, the result will be quite unpredictable without an exact specification of the principle of operation or detailed mechanism of the clock. If, as is probable, the result should not agree with the relativity transformation of the t-co-ordinate, the fact would be trivial ; it would simply indicate that the particular clock used recorded, when in motion, a different time-scale from that adopted in physical theory, in precisely the same way as the failure of an air thermometer to verify the laws of thermodynamics at low temperatures would indicate that the air thermometer under those conditions did not record the temperature-scale adopted in physical theory.

The significance of this conclusion lies in its relation to what is probably the most fundamentally important effect of modern physics—namely, the revision which it makes necessary in our ideas of that in our knowledge for which we depend on experience and that which can be acquired by pure reason. The transformation of the *t*-co-ordinate is not a fact of experience : it is a logical deduction from the experimental fact sometimes called the 'Fitzgerald contraction' and the convention of physics by which time is measured in terms of the space covered by a specified moving body. It can be shown, in fact[3], that the whole of the special theory of relativity follows logically from the effect of the 'Fitzgerald contraction' on the traditional definitions of classical physics.

There is no doubt that a great deal of knowledge which has been acquired by experiment, and for which we are still generally thought to be dependent thereon, is a necessary consequence of other knowledge. Sir Arthur Eddington takes an extreme view in this matter, and maintains that the whole of the laws of physics could, in principle, have been derived by reason without recourse to experience[4]. Those who accept the scientific tradition must hold this to be an obvious error, for a law of physics is by definition a rational statement of the regularities found in experience ; hence, no experience, no law. Any purely rational deduction of what is apparently a law of physics must be a deduction from certain premises, and if those premises are not guaranteed by experience they must be assumed arbitrarily. Other premises would have yielded other 'laws', and only experience can tell us which are the laws of physics.

Eddington's contention is based on the general theory of relativity and the quantum theory, and is, we hold, an over-generalization of the fact that those theories have shown that a little experience goes a long way in theory. The special theory of relativity alone is an inadequate criterion by which to judge it, but that compact department of physics affords an excellent example of both the power and the limitations of reason in the building-up of knowledge. By the wisdom of our ancestors, metrical physics has been constructed entirely in terms of one fundamental unit—that of length : all other units are, by definition, dependent on that. The experimental discovery of the dependence of length on velocity therefore creates a disturbance which travels through the whole of physics, and its effect is to show that certain conceptions, formerly thought to be independent and fundamentally necessary, are actually different forms of others already adopted. The identity of mass and energy, and the unity of the electromagnetic field and of the space-time continuum, are examples. But these achievements in no way remove the dependence of laws of physics on experience. They simply allow us to express in simpler terms the regularities found in experience. We may perhaps look forward to the time when a single conception—possibly a sufficiently elaborated 'space-time'—will suffice to express all the order which experience exhibits, and we may then predict all that lies ahead. But we can never be sure that, even in that event, our predictions will not be falsified and our laws will not need amendment.

---

[1] NATURE, **144**, 888 (1939).

[2] NATURE, **145**, 427 (1940).

[3] See "The Special Theory of Relativity" (Methuen's Monographs on Physical Subjects. In the press).

[4] "The Philosophy of Physical Science" (Camb. Univ. Press).

OBITUARIES

Prof. A. E. H. Love, F.R.S.

PROF. A. E. H. LOVE, Sedleian professor of natural philosophy in the University of Oxford, died on June 5, 1940, at the age of seventy-seven. Though of late years in frail health, he had been active in lecturing and attending to University business up to the time of his brief illness, and he had seemed well and brisk when meeting his colleagues at a sub-faculty meeting early in the summer term. He was unmarried ; his sister Blanche, whose devotion to his welfare was extreme, survives him.

Augustus Edward Hough Love—the name Hough arose from a connexion with the Cape astronomer of that name—was born at Weston-super-Mare on April 17, 1863 ; his father was police-surgeon to the Borough of Wolverhampton, and Love attended the Grammar School, Wolverhampton, from 1874 until 1881. The then headmaster was Thomas Beach, a man of some force of character ; and Love was taught mathematics by the Rev. Henry Williams, who afterwards succeeded Beach. Love maintained an attachment to his old school, giving an annual mathematical prize. Love is said to have been a little odd as a schoolboy—not an uncommon thing for mathematicians—and a certain whimsical touch endeared him to his friends throughout later life. He was awarded a sizarship at St. John's College, Cambridge, in 1881, and went into residence there in 1882. He became scholar of the College in June, 1884. He was Second Wrangler in Parts I and II of the Mathematical Tripos in 1885, between Anthony Berry and H. W. Richmond (both of King's) ; he was placed in Division I, Part III in 1886 and was awarded the

First Smith's Prize in 1887. He held a fellowship at St. John's College from 1886 until 1899 and became a College lecturer (two of his colleagues being R. R. Webb and Sir Joseph Larmor). This was a time of great mathematical activity for Love, and he was elected fellow of the Royal Society in 1894. It was then, too, that there commenced his long association with the London Mathematical Society; besides filling the presidential office, he served for fifteen years as an honorary secretary, and was altogether thirty-three years on its Council.

Love was elected to the Sedleian chair in Oxford in 1899, and the increased leisure allowed him even to increase his research activity in his chosen subjects of elasticity, geodynamics and electrodynamics. He won the Adams Prize at Cambridge in 1911 for an essay entitled "Some Problems in Geodynamics", which was soon afterwards published. He was awarded a Royal Medal in 1909, the De Morgan Medal of the London Mathematical Society in 1926 and, as a fitting tribute to his life-long devotion to mathematics, the Royal Society's Sylvester Medal in 1937. He was elected an honorary fellow of St. John's College in 1927, in which year also he became a fellow of the Queen's College, Oxford. His international standing was recognized by his associateship of the Academy of the Lincei and his election as a corresponding member of the Institute of France.

Love will chiefly be remembered for two outstanding achievements, his discovery of what afterwards became known as 'Love waves' and his authorship of his treatise on the "Mathematical Theory of Elasticity". It is a classical result that any disturbance in an elastic medium resolves itself into the propagation of trains of compressional and distortional (equivoluminal) waves in three dimensions, but it is not immediately obvious that there exists a mode of combination of such trains which results in the propagation of a disturbance in two dimensions over the *surface* of a semi-infinite elastic body. Such a form of waves was discovered by Rayleigh. Love showed that in a medium consisting of a superficial layer of one density and rigidity resting on a subjacent layer of different density and rigidity, there exists a new form of two-dimensional waves, decreasing in amplitude exponentially with depth, propagating themselves with a tangential disturbance transverse to the direction of propagation, and depending for their existence essentially on the heterogeneity of the medium. These are of importance in seismology. Love investigated the dispersion of such wave-trains, and the application of his methods in the hands of seismologists has led to important information about the crust of the earth. The essay on geodynamics in which these investigations first appeared has a completeness of mathematical detail which makes it attractive reading to-day, and which contrasts strangely with the modern suppression of details of mathematical technique in physical papers which came in after the War of 1914–18, owing to the need for compression. Love's sentences—whether in English or in symbolism—come with the leisurely perfection of the great memoirs of a former century.

The treatise on the "Mathematical Theory of Elasticity" stands in a class with Lamb's "Hydrodynamics", and is a classic. If a comparison between 'good' things is at all legitimate, it may be said that Love's work is if anything the more scholarly but the tougher reading, as befitting a more intractable subject. Love was essentially a mathematician, delighting in partial differential equations and spherical harmonics; the eye to applications was there, but he was no engineer. The "Elasticity", like Lamb's "Hydrodynamics", is academic in character, but what a joy does the academic reader derive from it, once properly afloat on that inland sea! Whether it be the foundations of the subject, the equilibrium of strained bodies, the torsion of prisms, the vibration of solids, the propagation of waves, the bending of beams, or the theory of thin shells, the whole is verifiable, calm, controlled by the mind of a master. Love was perhaps attracted to the subject because after a controversial start it had settled down into a subject in which the principles were well accepted and well understood; the mathematician could, up to a point, have complete confidence in the foundation on which he was building.

Love's lectures at Oxford were ever models of form, and he devoted much care to the preparation of courses on subjects outside his researches—notably on relativity and the tensor researches. In this connexion it is the more remarkable that in the "Elasticity" he scarcely recognizes that the components of strain on one hand and of stress on the other form tensors—three-dimensional symmetric tensors of a most instructive kind. His notation was in fact unfortunate, as it concealed the tensor nature of these entities; his Xy and Zx for components of stress are quite frankly abominations of un-symmetricality, and his omission of the factor $\frac{1}{2}$ in his definitions of the non-principal components of strain is disastrous in transformation formulæ. But everything may be forgiven to a man of Love's attractive geniality and modesty of character.

It is not generally known that Love, in the War of 1914–18, made a contribution to ballistics which resulted in 'Love's method' for the calculation of trajectories being applied for some time at Woolwich. No notice of him would be complete without a mention of his hobby of croquet. Oxford is the poorer by the loss of his characteristic figure on the croquet lawn in the parks.

E. A. MILNE.

The Duke of Bedford, K.G., K.B.E., F.R.S.

THE Duke of Bedford, who died on August 27 at the age of eighty-two, was elected to the Council of the Zoological Society of London in 1896. He was already known as an ardent and competent naturalist with a special interest in ducks, geese, cranes, gallinaceous birds, and herbivorous mammals. The foundation of his magnificent collection of animals at Woburn Park was already laid, and throughout his life he continued to improve it, spending large sums through the late Carl Hagenbeck and other collectors to add to its richness. He was not content with acquiring exotic animals; his great desire was to establish them and make breeding herds in Great Britain, and he acquired a unique knowledge of the conditions which made for success and failure. He was the first to introduce Prevalsky's wild horse to Europe. There is a small herd of the European bison, now extinct in its wild haunts, being nursed at Woburn, and he secured the last survivors of Père David's deer from the Royal Park at Pekin, so that there is at present in England the sole survivors of this unique species. Another accomplishment, very interesting to zoologists, is the successful acclimatization in the Woburn woods of the brush turkey.

On the Council of the Zoological Society, the Duke made the acquaintance of the late Mr. Oldfield Thomas, and began to subsidize collecting expeditions to Central Asia, Japan and China, with the result that the British Museum (Natural History) has an extraordinarily fine series of Chinese and Japanese mammals, including the types of many new species.

During his early years on the Council, the Duke, in his characteristically modest fashion, took little active part in its proceedings, but was a regular attendant and a shrewd observer. In 1899, on the death of Sir William Flower, he was elected president, a position which he held until he retired in 1936, and from then on, took a leading part in all the affairs of the Society. The great progress made during that time was due to his ready generosity, but still more to his wise but prudent counsel. On the resignation of P. L. Sclater, who had been secretary for many years, he appointed a special committee to examine the affairs of the Society and make plans for its reorganization. The control of the Council was made more direct; changes in staff and the allotment of duties were arranged. Financial control was strengthened; the general hygiene of the Gardens was vastly improved, and scientific investigation into the diseases and parasites affecting the animals—subjects in which the Duke took special interest—was arranged and provision for visitors was improved.

The financial position of the Society from increased numbers of fellows and of visitors quickly reacted to these changes, and it was possible to construct a large number of new buildings. The Duke was interested in all of them, but probably he was most deeply concerned with the Aquarium, and with the great experiment of Whipsnade. Jointly with the Fishmongers' Company he guaranteed an annual sinking fund to pay for the former, but fortunately the success was so great that the total cost was paid off from revenue in two years. Up to the last months of his life he took a deep interest in the progress of Whipsnade Park, remaining an honorary member of the Committee and visiting it frequently.

P. Chalmers Mitchell.

Prof. A. D. Arkhangelsky

The death occurred in a sanatorium near Moscow, on June 16, at the age of sixty, of Andrei Dmitrievich Arkhangelsky, one of the foremost geologists of the U.S.S.R. Prof. Arkhangelsky's investigations of the geology of the U.S.S.R., based on a study of the laws of the geological development of the earth's crust, are of great theoretical and practical importance. His work has proved an accurate guide in the search for useful minerals.

Prof. Arkhangelsky is noted for his work on the tectonics of the Russian platform, which contributed so much to the discovery of the deposits of iron ore in the Kursk magnetic anomaly and the oil resources of the region lying between the Volga and the Urals, now come to be known as the "Second Baku". The expedition, led by him, of the Academy of Sciences of the U.S.S.R., which made a geological study of the European part of the U.S.S.R., applying geophysical methods to prospecting, laid down the lines of future prospecting for oil, coal and iron.

Prof. Arkhangelsky rendered valuable service to his country in the training of new geological personnel. From the early years of the Soviet regime he took an active part in the reform of higher education. For a considerable period he was professor in the Moscow Mining Academy, the University of Moscow and the Moscow Geological Prospecting Institute. His course on "Geology of the U.S.S.R." has become a standard work for every Soviet geologist.

Prof. Arkhangelsky was elected a member of the Academy of Sciences of the U.S.S.R. in 1925.

Prof. S. Schönland

The death on April 24, at the age of seventy-nine, of Prof. S. Schönland marks the passing of a botanist of international repute.

Educated at the Universities of Berlin and Kiel, Schönland as a young man was assistant to the professor of botany at Berlin and later at Oxford. He went to South Africa in 1889 and shortly after was appointed director of the Albany Museum. In 1904 he was appointed as the first professor of botany at Rhodes University College, a position he held until his resignation in 1925.

His main interests lay in systematic botany, to which he made many and valuable contributions. His botanical work, however, also extended over many other aspects; he published papers on plant distribution, ecology, biology, and practical problems such as weed eradication.

Schönland was much interested in education, and he played a big part in the building up of the University of South Africa and especially of Rhodes University College.

We regret to announce the following deaths:

Sir Harold Carpenter, F.R.S., professor of metallurgy in the Royal School of Mines, Imperial College of Science and Technology, University of London, on September 13, aged sixty-five.

Prof. R. T. Hewlett, emeritus professor of bacteriology in the University of London, on September 10, aged seventy-five.

Miss E. L. Turner, the well-known field ornithologist, on August 13.

NEWS AND VIEWS

Educational Facilities for the Armed Forces

IN a leading article in NATURE of April 6, p. 526, attention was directed to the importance of providing adequate educational facilities for men and women in the armed forces. Evidence was available to show that, in the then period of comparative calm, there had been a regular and insistent demand for educational services from members of the Army and Air Force, and, in a different degree, the Navy. Suggestions are made to indicate how these demands might be reasonably met. An important announcement was that the Board of Education had agreed to nominate a senior officer to a liaison post between its own department and corresponding establishments in the Services. Since that time the development of the War has caused a temporary, although only partial, postponement of this and other schemes for expanding educational programmes for the fighting forces. The recent statement announcing the appointment of Mr. F. W. D. Bendall of the Board of Education to act as adviser in educational matters to Service men and women must therefore be greeted with considerable enthusiasm. It is to be hoped that with any lull in the air battles over Great Britain during the coming winter, opportunity for making use of the existing schemes that have been carefully prepared, and any others that might arise, should be freely utilized.

It is encouraging to record that, despite the bewildering changes of the last few months, steady progress has been made in catering for those periods when members of the forces are not taking part in more rigorous military duties. Single lectures on topics of current interest have been given to appreciative audiences in many areas, while instructional courses in various subjects have been highly acclaimed. Among these, particular reference must be made to certain classes in arts and crafts of varying types that have been successful with soldiers, sailors and airmen who were convalescing after injury. For these results, much credit is due to the Central Advisory Council for Adult Education in H.M. Forces. In the Army it is heartening to learn that the Army Educational Corps, which has been largely instrumental in arranging the details of the programmes which are already in operation, has been actively seizing every opportunity for increasing the range of its work. The value of the Army Educational Corps and the corresponding organization in the Royal Air Force, when viewed in the light of Mr. Bendall's appointment, seems to have been given well-earned, if belated, recognition. An increase in the establishment and range of these organizations seems to be the next logical step. An announcement to this effect could not be greeted with anything but acclamation by educationists.

Racial Freedom and the Colour Bar

THE open letter dealing with racial freedom and the abolition of the colour bar, which bears the signatures of the leaders of the organized religious bodies of Great Britain, headed by the Archbishop of Canterbury, and issued with the support of Cardinal Hinsley, Archbishop of Westminster, carries to its logical conclusion the full implication of the repudiation by members of the Christian faith of the doctrine of racial dominance held by Nazi Germany, with its train of misery and injustice (*The Times*, Sept. 12). It takes the British Government's "Statement of Policy on Colonial Development and Welfare" as the most authoritative of numerous recent reassertions of the British tradition, and points out not only that it proves the serious purpose of His Majesty's Government, but also that the full value of that generous gesture of a promised expenditure of £55,000,000 on improving health, education and economic conditions among colonial peoples can be realized only "if the worth of the individual members of the Empire comes to be measured by personal character and ability rather than by the colour of their skins or the accidental circumstances of birth". It is well that it should be impressed upon the British people how largely the British Empire is a coloured Empire—a fact, as we are here reminded, upon which the general public is insufficiently informed—and that the unity necessary to its survival can be secured only if the principle of equality as between people of different race and colour "is applied in methods of government and in human relationships alike in Europe and in Asia or Africa". The letter concludes by calling upon all who value the principles upon which the British Empire has been built up to join in an effort to secure the removal of certain disabilities, in the forefront of which stands as fundamental "the barriers of race and colour which exist to-day in British colonies", while at the same time it enjoins the creation of an informed public opinion in Great Britain which will no longer acquiesce passively in applications of the colour bar, now to be observed in certain circumstances.

The Archbishop of Canterbury and his co-signatories affirm the identity of the tradition to which expression is given in their declaration with the Christian tradition, of which, they say, the prejudice which erects a colour bar or prompts racial exclusiveness is a denial. This tradition, however, as has been stated again and again with the strongest emphasis, is one with which science is in full accord in both theory and practice in advancing knowledge and promoting the well-being of mankind. In the attainment of its aim of enlarging the spirit of man through the increase of knowledge of the universe, it recognizes no distinction of race or creed in its servants, no bar among those to whom its benefits are laid open. At the same time, however, while science maintains the validity of its faith in its own field, it recognizes that in practical everyday affairs a like disregard of such racial and other differences as those which lie at the root of the colour bar is not to be attained merely by pious aspiration or exhortation. The colour bar is not entirely a product of that racial prejudice and exclusiveness to which such exhortation is addressed. Its roots extend to cultural, social and economic conditions, from which spring problems demanding the closest examination and study before their solution will bring about that co-operation between different classes in the community, each according to its kind and its capacities, instead of present antagonisms. This constitutes the real elimination of the colour bar—a partnership in realities and not a brotherhood by adoption in which the conditions of unity have yet to be attained.

Road Travel in Air Raids

A new aspect of road safety emerges with the decision to allow road traffic to continue during air-raid warnings. General agreement seems to have been arrived at that this decision is a wise one. As pointed out in *Roads and Road Construction* of September 2, the long lines of vehicles held up during the early raids, with their occupants standing about waiting for something to happen, presented an excellent target for machine-guns. It is difficult to see what other course could have been taken. Judging by experience learned from recent raids, many motorists are taking advantage of this concession. Travelling along roads deserted of all but police and A.R.P. personnel is a curious experience; and so is the feeling of frustration in a closed car produced by inability to see what is going on overhead. Something of what is happening can be guessed from the attitude of wardens and others, but in the absence of exact knowledge one tends to develop what has been called a sort of 'musical chairs' attitude towards the public shelters passed when driving, the question now being where the music (?) will start—not when it will stop. It has been suggested that something might be done to give motorists a feeling of greater security, or rather to reduce their feeling of insecurity, by way of signposting shelters along the main traffic routes. In many places signs have already been erected, but these are scarcely conspicuous enough to be seen by passing traffic; they cater more for the local inhabitants. Shops and private houses with surplus shelter accommodation might also be induced to co-operate.

Medicinal Herb Production in Great Britain

A short memorandum, presumably a preliminary one, has been issued by the Ministry of Health declaring its policy regarding the domestic cultivation of medicinal plants and outlining the arrangements which have already been made in respect of belladonna, digitalis, henbane and stramonium. These four potent drugs are to be made the special care of the Ministry, and it is understood that the owners of established herb farms have undertaken to extend the acreages under cultivation. Outside effort is not discouraged; but, as the memorandum states, "Farmers and owners of large private gardens who wish to engage in the cultivation of herbs are recommended to operate in close association with commercial firms to ensure that the crop is properly harvested and dealt with". This is sound advice, and if followed will help amateur gardeners to avoid pitfalls, which are not a few in number. It is hoped that the deficiency of supplies of these four important drugs, which is due to the cessation of imports from Continental sources, will be made up by greatly increased home production. The Ministry has given no guidance with regard to the many other herbs which, although of lesser medical importance than the four specifically named plants, are of considerable commercial interest as household remedies. The matter might perhaps be taken up by the Ministry of Agriculture, and the Board of Education might give official advice about the collection of herbs by school children.

Rectifier Plant in Time of War

It has been doubted by some engineers whether the glass bulb devices used in some electric stations for converting alternating into direct current are able to withstand the blast and other effects of aerial bombing. It has to be remembered that the bulbs, being spherical, present a minimum surface to blast contact. They are flexibly mounted and are made of a special toughened high-grade glass. They are always operating under an external atmospheric pressure of approximately 15 lb. per sq. in. (as the bulbs are various). This is equivalent to a total pressure of about 20 tons in the case of a large rectifier bulb and so its inherent strength is very considerable. It has been computed that one ton of high explosive will cause a blast pressure of about $2\frac{1}{2}$ lb. per sq. in. at 100 yd. distance. Such a pressure might be sufficient to knock down a 9-in. brick wall (because of the large resistance surface it presents), for $2\frac{1}{2}$ lb. per sq. in. is the equivalent of $1\frac{1}{2}$ tons per sq. yd. A rectifier bulb is always working at 15 lb. per sq. in. and can withstand many times this amount.

A further point is that the bulbs are always installed inside sheet steel cubicles, and the cubicles are generally housed inside a building. The concussion effect that can reach a bulb through the walls of the building and the walls of the cubicles is only a small fraction of the blast impinged on the external sub-station walls. The bulbs can withstand much higher pressures than the normal sub-station walls and yet it is the walls that must take the brunt of the blast. Finally, the multi-unit construction of the glass bulb rectifier makes it far less vulnerable than most other types of plant to the secondary effects of aerial warfare, as for example, shrapnel. *Electrical Industries* of September 2 points out that a splinter which would be sufficient to put a one-unit type of plant, whether static or rotary, out of operation, would probably damage at most one cubicle of a bulb rectifier plant.

Guide to Fuel and Allied Industries

The War has profoundly influenced life, industry and technology, and especially in all that concerns fuel and allied industries. Organizations have been modified, their activities suspended and new ones established. As a result people concerned are often at a loss for addresses and sources of information. To meet this need, the Association of Special Libraries and Information Bureaux has issued "ASLIB Guide to British Sources of Specialised Information. No. 1, Fuel and Allied Industries (excluding Electricity)" (2*s*. 6*d*. to non-members. ASLIB, 31 Museum Street, London, W.C.1). It indicates what new organizations have arisen and what modifications have been made in war-time. Particulars are given of relevant Government and other departments, professional, trade, and research organizations, university teaching departments and libraries, commercial and industrial organizations, periodicals printing abstracts and references, trade periodicals, periodicals issued by professional bodies and industrial concerns, and annuals. The list is comprehensive, and a perusal failed to note the omission of any address or paper concerned with fuels in war-time. It should find a useful place on the table of everyone concerned with administration or investigation of fuel affairs in these times.

William Withering and Erasmus Darwin

THE June issue of the *Bulletin of the History of Medicine* contains an interesting notice by Drs. Ruth Musser and John C. Krantz, jun., on the friendship of William Withering and Erasmus Darwin. In 1775, nine years after graduating as M.D. at Edinburgh, Withering, who was in practice at Birmingham, became intimately associated with Erasmus Darwin, an Edinburgh doctor of medicine ten years his senior, and was admitted by him to the Lunar Society which Darwin and others had founded. The outstanding members of this Society were James Watt, Joseph Priestley and Josiah Wedgwood, and the visitors included among others Herschel and Benjamin Franklin. The friendship of Darwin and Withering continued for many years. Each enjoyed a wide reputation and an extensive practice. The greatest contribution which Withering made to posterity was his use of the purple foxglove in the treatment of dropsy, the description of which is to be found in his classical work published in 1785 entitled "The Foxglove, an Account of its Medical Properties", while of Darwin it has been said that there was scarcely an invention in the world to-day that his mind did not foresee. Withering died in 1799 at the relatively early age of fifty-three, but Darwin survived until 1802, or seven years before the birth of his grandson, the author of "The Origin of Species".

The Newcomen Society

THE Newcomen Society has recently published vol. 19 of its *Transactions*, its sixth *Quarterly Bulletin* and its programme of papers for the session 1940–41. Seven meetings have been arranged, and the papers to be presented deal with the history of many subjects, among these being the sugar-cane industry, the iron industry, Henry Corte's bicentenary, the Surrey iron railway, needle-making, wire and plate gauges and the hydraulic extrusion of metals. In the *Quarterly Bulletin*, reference is made to the movement in the United States to preserve the birthplace of Robert Fulton, and to the erection of a tablet on a granite shaft over the burial place of Oliver Evans, in Trinity Churchyard, Broadway, New York. The 'pilgrimage' of members of the Society in America which was to have taken place in New Hampshire in June was abandoned on the receipt of the news of the defeat of France.

The new volume of the *Transactions* contains thirteen papers and nine other communications, together with a continuation of the valuable analytical bibliography of the history of engineering The volume runs to 290 pages and contains twenty-four plates. Most of the papers were referred to in our columns at the time they were read. Among the notes and communications is a list of 320 engineering drawings dating from 1775 to 1840 preserved at the Science Museum in the Goodrich Collection, and a description of the first dry dock in the Netherlands (1707) by Lieut. J. J. Bootsgezel, of the Netherland Royal Navy, who, it has been learnt, lost his life through a mine when escaping from Holland. He was well known for his great interest in the records of Dutch engineering. The president of the Society for the current year is Col. C. E. Davies, secretary of the American Society of Mechanical Engineers; his address will be read in both New York and London on November 13.

Electromagnetic Levitation

AN exhibit which has proved attractive at the Centennial Exhibition of the Dominion of New Zealand is showing an aluminium plate floating in air in a strong alternating-current field and frying eggs in a pan without visible means of heating and support. An iron core is concealed beneath a table top and excited by A.C. windings so arranged and connected that they produce alternating magnetic fields, toroidal in form, of high intensity and opposite polarity. An aluminium pan floats on this field with such definition of position that considerable effort is required to move it downwards or sideways. Heat generated in the pan, by currents induced by the field, does the cooking. It is very suitable as an exhibit for publicity purposes, but at present it does not look as if it has any practical application, as a very large electrical input is required to maintain a magnetic field of suitable form and intensity.

Seismological Data from India

MUCH useful seismological data is contained in the *Seismological Bulletin* of April, May and June, 1939, recently published by the Government of India Meteorological Department. It contains interpretations of the seismograms obtained at seven observatories in India and Ceylon together with macroseismic data supplied by voluntary observers in nine regions. About sixty earthquakes were recorded at each of the observatories for the three months, though only nineteen were registered at the Haig Observatory at Dehra Dun. This is not considered significant on account of the types of instruments in use at the stations, a full list of which is given. The region near Shillong appears to have experienced more earthquakes than any other during the period, having had five on four separate days. The most intense activity, however, seems to have been near Silchar on May 27, 1939, when eight shocks were felt attaining a maximum intensity seven on the Rossi-Forel scale (overturning of loose objects ; fall of plaster ; general fright, though no damage to property). The total duration of shaking was approximately 3½ minutes.

Undulant Fever in Normandy

IN his inaugural thesis (*Thèse de Paris*, 1940, No. 322), Dr. M. L. Rose-Legrand remarks that until the last few years the five departments of Normandy were regarded as free from human undulant fever. Recent publications, however, indicate that Normandy has by no means escaped visitations of this disease, as is shown by the fact that the writer has been able to collect at least twenty-seven cases in the course of the last six years, eleven being in Seine-Inférieure, six in Calvados, five in Eure, three in Manche and one in Orne. With the exception of a single case caused by *B. melitensis*, all the cases of human undulant fever have resulted from infection by *B. abortus bovis*. Not a single case in the departments of Normandy has been due to goats or sheep. In two instances infection was caused by accidental inoculation, namely, by a polyvalent vaccine in a veterinary surgeon, and in another in a cattle breeder. In the majority of cases inoculation has taken place through the skin and only in a minority by consumption of raw milk from infected cows. Hitherto, there have been no instances of human infection by cheese. In conclusion, the writer recommends that the well-established existence of undulant fever in Normandy should receive the attention of veterinary and medical practitioners, especially in rural districts. In another thesis (*Thèse de Paris*, 1940, No. 277), Dr. R. G. C. F. Grigny states that he has recently collected ten cases of undulant fever which have occurred during the last four years in the department of the Somme, where contagious abortion has recently been frequent among the cattle.

Carnegie Institution of Washington

YEAR BOOK No. 38 of the Carnegie Institution of Washington has been issued and covers the year July 1, 1938–June 30, 1939. It includes the report of the President, the reports of the various Departments, including the Mount Wilson Observatory, the Geophysical Laboratory, the Department of Terrestrial Magnetism, the Division of Plant Biology, the Division of Animal Biology and the Division of Historical Research, as well as reports on investigations by research associates and on special co-operative studies such as those of the committee on co-ordination of cosmic ray investigations. The astronomical staff at Mount Wilson has continued to co-operate with the physicists and engineers of the Californian Institute of Technology in the construction of the 200-inch telescope with the aid of funds furnished by the Rockefeller Foundation.

The Department of Terrestrial Magnetism, in co-operation with George Washington University, held a conference on theoretical physics in the spring, and keen interest was also taken in a similar conference on the ionosphere. Special reference is made in the report to the work of the Division of Plant Biology on photosynthesis, including studies of the quantum efficiency of photosynthesis. The work of the Division of Animal Biology has included biochemical studies of secretion, the physiology of reproduction, endocrine studies, studies of the central nervous system, as well as investigations on the chromosome and the gene. Research activities in the Nutrition Laboratory have centred largely around the factors governing heat regulation and heat production in animals and human beings.

A Guide to Farming

THE fifteenth issue of the "Farmer's Guide" has been published in the *Journal of the Royal Agricultural Society of England*, 101, Part 1. It follows the lines of former issues, but naturally a good deal of the work under review bears on the special problems of war-time farming. The contributors to the various sections are the same as last year, except that Prof. T. Dalling has replaced Dr. F. C. Minett as the writer on animal diseases. In future the *Journal* will be issued in two parts only, at half-yearly intervals, instead of in three parts as originally planned. So far as can be foreseen at present, Part 2 of the current volume will be published in March 1941.

Announcements

IN connexion with Dr. R. Melville's letter on p. 403 of this issue, it may be noted that the Board of Education has issued a memorandum suggesting the collection by school children of wool, dandelion roots, autumn crocus roots and seeds, acorns and beech mast, and horse chestnuts.

DR. IVOR JENNING has been appointed principal of the University College of Ceylon, and Mr. Stanley A. A. Hammond educational adviser on the West Indian Comptroller's staff.

ACCORDING to *Science*, Dr. Bruno Gerhard, formerly curator of the Museum of Hygiene in Dresden, has been appointed director of the Cleveland Museum of Health and Hygiene, which will open in October. Since 1937, Dr. Gerhard has been serving as technical consultant for the medicine and public health exhibits at the World's Fair in New York. Plans for the Cleveland Museum were initiated in 1939 when Mrs. Francis F. Prentiss gave the building. In addition to exhibits for education in public health, the museum expects to have workshops for the creation of visual health aids for schools, colleges and other educational institutions.

DR. JOSEPH NEEDHAM has pointed out that a misprint appears in the title of an article by him in association with Dr. A. S. C. Lawrence and Dr. Shih-Chang Shen in NATURE of July 20, p. 104. The full title of the original paper was "Studies on Protein Solutions with the Co-axial (or Couette) Viscosimeter, with reference to the Relations between Molecular and Morphological Shape" ; this would of course have been too cumbersome for an article in NATURE.

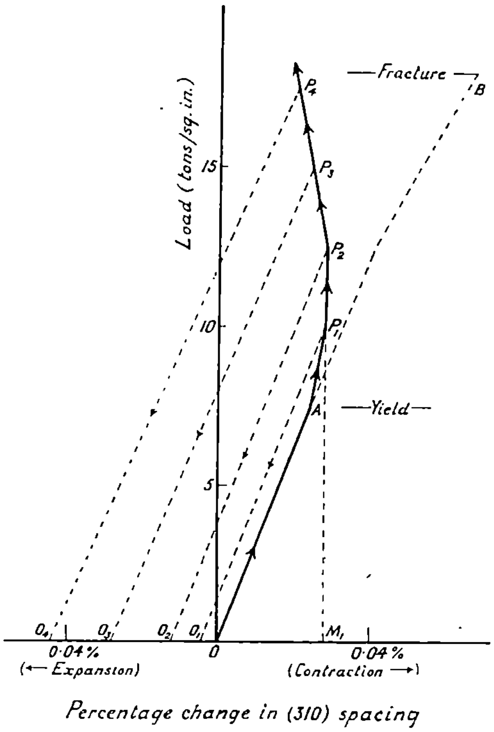
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

A Lattice Stress-Strain Diagram

THE technical application of metals involves a detailed knowledge of their behaviour under external stresses. In the usual method of testing, measurements are made of the changes in external dimensions of a test piece when stresses of known magnitude are applied, as in the determination of the elementary load extension diagram. It is nowadays practicable, however, by use of modern X-ray diffraction technique, to obtain simultaneously with the external load-extension diagram the analogous diagram for the atomic lattice itself, in which direct measurements are made of the displacements of the atoms from their normal positions under stress and of their recovery when the applied stress is removed.



The 'lattice stress-strain diagram', as it may be termed, presents novel features of theoretical and practical interest. The main characteristics may be illustrated by the accompanying figure, which records measurements made on pure iron in the following way. When a metal is stretched in one direction, it contracts by a related amount in the perpendicular direction, and the measurements refer to the contraction in this latter direction of selected atomic planes, here the (310). The contraction in the spacing of these planes has been plotted against the applied tensile stress.

The load-contraction curve then obtained is given by $0AP_4$. Up to the external yield point, which corresponds to the point A, the contraction in atomic spacing is proportional within limits of measurement to the applied stress. Beyond the yield point, however, the contraction proceeds at a slower rate and reaches a limiting value indicated at P_1P_2. With still further increase in stress the atomic spacing actually tends to expand.

If the stress applied is less than the yield value, the atomic spacing returns to its original value upon removal of the load. In the range $0A$, therefore, the atomic displacements are reversible and in accordance with Hooke's law. If, however, the applied stress is greater than the yield value then, when the stress is removed, the contracted spacing does not merely return to its normal value during recovery, but passes beyond that value and ends up with an expanded value, which persists indefinitely at room temperature. Thus, on unloading from the point P_1, the curve follows the line P_10_1 and the atomic spacing exhibits the permanent expansion 00_1 over the normal value at 0. The greater the load involved, the greater is the final permanent set imposed on the atomic spacing, an effect illustrated by the further lines P_20_2, P_30_3 . . .

If after being unloaded from P_1 the specimen is reloaded to the same stress, then the curve, commencing at 0_1, follows the line 0_1P_1, the total range of contraction being then 0_1M_1. This total range increases with the value of the applied stress up to the fracture stage as shown by the additional curve $0B$.

The lattice load-contraction diagram thus reveals information on the properties of the metallic state which could not have been deduced from consideration of the corresponding external load-contraction diagram. We may conclude that two processes occur upon loading a specimen: first, a contraction of the atomic spacing which, since the external dimensions also contract, is to be expected, and, second, as the yield point is exceeded, some form of distortion which results in a permanent expansion of the lattice. It is as if the metal, though actually at room temperature throughout, were undergoing a rise in temperature and that the expansion thus resulting was imposed on the contraction due to the simultaneous external elastic deformation. This expansion is retained by the lattice spacing after removal of the load and represents an absorption of energy or 'latent energy' due to cold work. Its observation is of particular interest since it provides a systematic approach to the study of the phenomena, often exhibited by metals, which have been vaguely classified under the heading of 'internal strains'.

W. A. WOOD.
Physics Department,

S. L. SMITH.
Engineering Department,
National Physical Laboratory,
Teddington, Middlesex.

August 20.

Excited States of Stable Nuclei

In Nature of June 8, Powell, May, Chadwick and Pickavance report the use of a camera connected with the cyclotron to study the scattering of high energy particles. Such a camera has been in use by me for more than a year[1]. A picture of the camera was shown in the Royal Photographic Society exhibit last July and a description published[2]. The detection of elastic and inelastic groups for scattered protons has also been reported[3]. For 6·7 Mev. protons the inelastic group in the case of magnesium is relatively slightly larger than shown for neon in the experiments reported by Powell and for aluminium is smaller. In both cases 6·7 Mev. protons have been used. The peak separation for aluminium is about 0·8 Mev. and for magnesium, 1·3. Experiments have also been made with deuterons which will be reported shortly.

T. R. Wilkins.

University of Rochester,
New York.
July 19.

[1] Wilkins, T. R., and Kuerti, G., *Phys. Rev.*, **55**, 1134 (1939); Kuerti, G., and Wilkins, T. R., *Phys. Rev.*, **57**, 1081 (1940).

[2] Wilkins, T. R., *J. App. Phys.*, **11**, 44 (1940).

[3] Wilkins, T. R., and Kuerti, G., *Phys. Rev.*, **57**, 1082 (1940).

The facts quoted by Prof. Wilkins are plain; but these alone, and put in this way, may suggest more than he intends. It has often happened that similar experiments have been carried out at the same time in different laboratories, and I have no doubt it will happen again. The note by Prof. Wilkins and G. Kuerti on the detection of inelastically scattered protons appeared in the *Physical Review* of June 1, and thus before the letter of my colleagues and myself. Prof. Wilkins's experiments and ours have much in common, for they not only deal with the same phenomena but also use the same method for detecting and recording the scattered particles, namely, the photographic plate. The actual arrangements, that is, the 'camera' designs, appear, however, to differ considerably. We were of course unaware of his results at the time of our communication to these columns.

J. Chadwick.

George Holt Physics Laboratory,
University of Liverpool.

Velocity of Hydration of Carbon Dioxide in the Presence of Extraneous Substances

The available biological and chemical evidence indicates that the effective germicidal life of aerosols containing sodium hypochlorite depends on the velocity of changes occurring between the collisions of carbon dioxide molecules in the air with droplets of the aerosol, and the appearance of the corresponding hydrogen ions. One of the changes concerned, namely the hydration of the dissolved gas, has been shown by McBain[1] to be a measurably slow reaction, and it is therefore of interest to determine the effect of the salts normally present, and of other substances, upon it.

The differences in the hydration velocity in the presence of salts and certain organic compounds were studied by McBain's method: a slight excess of a saturated aqueous solution of carbon dioxide was added quickly to an alkaline (0·08 M K_2CO_3) solution of the test substance containing phenolphthalein, and the colour change timed against permanent standards. Control runs with alkali and carbon dioxide only were alternated with at least three test runs in each case.

Potassium chloride and bromide, and sodium nitrate and formate had no influence in concentrations up to $1M$. The absence of a salt effect indicates that the reaction concerned is actually $H_2O + CO_2 \rightarrow H_2CO_3$ rather than $^1HO + CO_2 \rightarrow {}^1HCO_3$[2].

Alcohols of very diverse types, and also dioxane, were found to accelerate the reaction. The following is the order of increasing effect; figures in parentheses give the maximum limit of concentration tested: Dioxane ($2M$), methyl alcohol ($2M$), potassium sodium tartrate (that is, ethylene glycol dicarboxylate) ($1M$), β-ethoxy ethyl alcohol ($2M$), glycerol ($2M$).

Glucose ($1M$), and still more sucrose ($\frac{1}{2}M$) retarded the reaction very greatly.

The effect of a retarding or accelerating substance was the same in the presence of inactive salts as in their absence, and there were no differences on substituting sodium for potassium carbonate as the neutralizing alkali.

In the aerosols containing hypochlorites, where high concentrations are immediately reached by evaporation[3], the droplets can be expected to dissolve only small quantities of carbon dioxide as such, so that in this case at least the hydration of the latter may play as important a part as the purely physical factors which have usually been invoked to explain its rates of absorption in various alkaline solutions[4]. Simple hypochlorite aerosols have an extremely short active life, which is, however, increased by the addition of glycerol[5]. This may be due to the toxicity of glycerol itself (or of its oxidation products), but if it depends at all on physico-chemical effects it should be possible to prolong the action still further by using, instead of glycerol, substances which retard the hydration of carbon dioxide as well as its absorption and diffusion.

E. O. Powell.

76 Stratford Street,
Iffley Road,
Oxford.
August 29.

[1] McBain, J. W., *J. Chem. Soc.* (Trans.), **101**, 814 (1912).

[2] Thiel, A., and Strohecker, R., *Ber. deutsch. chem. Ges.*, **47**, 1061 (1914).

[3] Finn, S. R., and Powell, E. O., Nature, **144**, 864 (1939).

[4] Killeffer, D. H., *Indus. Eng. Chem.* (Indus. Edn.), **29**, 1293 (1937).

[5] Finn, S. R., and Baker, A. H., Private communication.

Parahydrogen Conversion on Tungsten

This reaction[1] has been reinvestigated using a reaction tube containing a second short filament adjacent to the catalyst filament, so that adsorbed films on the latter might be detected by a measurement of their contact potential[2]. In this way it was shown that the filament in its most catalytically active state was free from adsorbed oxygen. Under these conditions, as J. K. Roberts[3] has pointed out, the clean wire on exposure to gaseous H_2 takes up a *stable* film of hydrogen, which does not evaporate appreciably at room temperature, and so cannot give a *para* H_2 conversion by the mechanism suggested by Farkas[1], namely by $H_2 + 2W \rightleftharpoons 2WH$ (where W indicates a surface atom of tungsten). It is, however, possible[4] that the conversion might occur by a surface interchange reaction of the type $pH_2 + WH \rightarrow oH_2 + HW$, and this mechanism gains support from the following experiment.

By evaporation from a tungsten wire under best high-vacuum conditions it was found possible to prepare clean films of tungsten on the glass walls, of real surface area of the order of 500 cm.[2]. This area was estimated from the amount of hydrogen instantly adsorbed at room temperature, which could not be pumped off at this temperature, as measured on a McLeod gauge. These films brought about the equilibria $pH_2 \rightleftharpoons oH_2$ and $H_2 + D_2 \rightleftharpoons 2HD$ within a few minutes at 77° K. Such a film was contacted with D_2 gas and carefully pumped at room temperature so as to give a WD surface. It was then cooled to 77° K. and exposed to a low pressure of hydrogen, when an interchange of atoms was observed in a time similar to that required for the *ortho para* conversion. Such interchanges were also detected at 193° K. and 293° K. We can, therefore, infer that the *para* H_2 conversion occurs by a similar surface interchange between gaseous H_2 and the stable W-H film. These results will be presented and discussed in detail in another place.

D. D. ELEY.
E. K. RIDEAL.

Department of Colloid Science,
The University,
Cambridge.
Sept. 2.

---

[1] Farkas, A., *Z. physikal. Chemie*, B, **14**, 371 (1931).

[2] Bosworth, R. C. L., and Rideal, E. K., *Proc. Roy. Soc.*, A, **162**, 1 (1937); Bosworth, R. C. L., *Proc. Camb. Phil. Soc.*, **33**, 394 (1937).

[3] Roberts, J. K., *Trans. Faraday Soc.*, **35**, 941 (1939).

[4] Rideal, E. K., *Proc. Camb. Phil. Soc.*, **35**, 130 (1939).

Fat: an Index of Œstrogen and Progestogen Activity in the Human Endometrium

WHILE carrying out a microchemical survey of the human endometrium attention was directed to the remarkable shifts of Sharlach *R* stainable fats in frozen sections of the human endometrium during the menstrual cycle.

In the œstrogen phase there is scarcely any fat in the glandular epithelium, and where it is present it is usually found in the supranuclear region; but even there it is rare. The stromal cells, however, may contain very fine droplets 1–4 in number situated close to one or other pole of the nucleus.

In the late progestogen phase, there is a remarkable accumulation of fat in glandular epithelium and the red staining fat is seen as fine globules localized exclusively to the proximal third or half of the cell immediately below the nucleus. Occasional stromal cells may contain a few very fine globules of fat.

On the first day of menstruation in some of the desquamating epithelium, the fat may extend throughout the cytoplasm but some of the surviving cells still preserve their basal fat, which is much reduced in quantity. In very early pregnancy, basal fat, in increased amounts, is invariably present in the epithelium of the uterine glands; this fat persists until the fourth or fifth month of gestation, when it is found as large globules scattered throughout the cytoplasm of the very much-flattened cell.

The accumulation of basal fat in the epithelium of the uterine gland has been shown to occur in women under progesterone treatment in the second half of the cycle. It has even been possible to determine by this method whether too much progesterone has been used.

By using the fat test clinically, evidence is rapidly accumulating to show that excess of œstrogen in the presence of insufficient progestogen will lead to an extraordinary accumulation of stromal fat, but the uterine epithelium contains almost none. Basal fat in the uterine glands of the human female can probably be regarded as a test for the presence of *optimum* quantities of progesterone, since it is absent when only œstrogen is present and is found towards the end of the second half of the normal cycle; it can be induced by progesterone therapy, and it is invariably found in the uterine cells in early pregnancy, persisting at least until the fourth or fifth month of gestation.

JOSEPH GILLMAN.

Department of Anatomy,
University of the Witwatersrand,
Johannesburg.
August 1.

Classification of Hominidæ

PROF. G. MONTANDON[1] has recently discussed my propositions concerning nomenclature in physical anthropology and offers a classification of the Hominidæ. These appear to call for some remark. Montandon objects to my delimitation of "species", and prefers to go back to the old, pre-Darwinian concept of a species being a group of individuals which are fertile *inter se*. There seems no need here to go into the pros and cons of that argument as it has already been dealt with by Pycraft[2] in the paper already quoted by me. Pycraft very aptly used the Phasianidæ to illustrate his point, as this group is quite comparable to the Hominidæ. No modern systematic zoologist accepts that old definition of species. Actually, as Zuckerman[3] points out, the value of species does differ among different animal groups, and the question of being fertile *inter se* or not depends on the magnitude of the chromosomal difference between related or neighbouring populations. Sometimes species of the same genus have greater chromosomal differences than those of other genera. The latter may produce fertile hybrids whilst the former cannot produce anything beyond an F_1 generation. Hominids would appear to belong to the latter category, and I maintain that such obvious anatomical differences as those between, say, Negroids and Mongoloids are sufficient to demand specific status for these two forms of modern man.

The classification of the Hominidæ set forth by Montandon includes, under the subfamily title Paranthropinæ, the newly discovered anthropoid genera Paranthropus and Plesianthropus, as well as the older Australopithecus. No one has claimed Hominid status for Paranthropus or Pleisianthropus, whilst Australopithecus was originally relegated by Dart[4] to a distinct family (Australopithecidæ). Recently Dart[5] has demanded Hominid status for this form, though most authorities still regard it as anthropoid. There seems little justification as yet for raising this form, together with its allies, to the rank of a subfamily of Hominidæ as Montandon's classification requires. In any event the name could not be Paranthropinæ according to international rules of nomenclature, but would have to be based on the name of the first known genus.

There may be some justification for giving subfamiliar rank to Pithecanthropus and its relatives; but, here again the name should be Pithecanthropinæ, and not Anthropinæ. The rules of nomenclature have also been broken in the remaining proposed subfamily Homininæ, new names, for example, *protosapiens*, being suggested without reference to any previously available names. Again, Neanderthal man is ranked as a subspecific form, presumably the typical subspecies of *H. primigenius*, but labelled *H. p. neandertalensis*, and stated to be further divisible into "diverses races".

Thus, though the general arrangement may be fairly satisfactory so far as present knowledge goes, and is clearly based on the results of the most recent work, considerable revision of the names adopted is necessary besides modifications of the exact status of some of the forms included.

W. C. Osman Hill.

Medical College,
Colombo.

---

[1] Montandon, *Revue Scientifique*, 172–173 (March 1940).

[2] Pycraft, *Man*, **25**, No. 99 (1925).

[3] Zuckerman, Nature, **145**, 510 (1940).

[4] Dart, Nature, **115**, 195, 199 (1925).

[5] Dart, *Amer. J. Phys. Anthrop.*, **26**, 176–186 (1940).

Wild Seeds as Animal Feeding Stuffs

In his discussion of the supply of animal feeding stuffs[1] Dr. Norman C. Wright does not consider the collection and utilization of wild seeds such as horse chestnuts, acorns, and beech mast. Even if the whole of the present bumper crop of horse chestnuts and acorns were collected, it obviously would not counterbalance the estimated 10 million ton deficiency in imported foodstuffs, but would nevertheless provide a substantial addition to existing stocks which should not be allowed to go to waste.

When in good condition horse chestnuts and acorns are nutritious foods, their value depending largely on a high starch content. Horse chestnuts can be fed at a rate of ½–1 lb. per head, per day, for sheep, or 4–10 lb. for dairy cattle, or up to 20 lb. per day for fattening cattle[2]. Most animals soon become used to the slightly bitter flavour of the nuts, though pigs persistently refuse them. They can be fed fresh, but probably the best way of dealing with the nuts would be to collect them at central depots where facilities were available for drying and grinding to a meal. Mouldy nuts should not be fed unprepared. There must be thousands of trees in the country each now bearing ½–1 cwt. of nuts.

Acorns have long been recognized as a valuable food for pigs, and the custom of pannage was strongly established in medieval England. They can be fed in small quantities to sheep and older cattle, but young cattle are susceptible to acorn poisoning, especially in years of drought, and should not be given them. Acorns can be fed fresh or dried. They keep for a long time in good condition if buried in pits in the same way as root crops.

A leaflet[3] just published by the Ministry of Agriculture gives advice on the use of acorns, horse chestnuts and beech mast as feeding stuffs. During the War of 1914–18, collections of the nuts were made by schoolchildren and organized by the Board of Education. Similar emergency measures might well be considered this year, but prompt action must be taken if the crop is to be utilized.

R. Melville.

Royal Botanic Gardens,
Kew. Sept. 7.

---

[1] Wright, N. C., Nature, **146**, 251 (1940).

[2] Anon., *J. Board Agric.*, **21**, 511–528 (1914).

[3] "Growmore" Leaflet No. 39, Min. of Agric. (1940).

The Functions of Science

There is one persistent feature of the current discussion on the social function of science which is very disquieting. Natural science offers to society at large, as well as to the individual man of science, several distinct benefits. One is simply the existence of an organized body of knowledge, accessible to those interested in it; for science, like every other intellectual discipline, is to be valued in itself for the truth which it contains. Another is the existence of a body of men trained to appreciate this knowledge, and acquainted with the arduous work of gathering data and interpreting them; good scientific work demands that the man of science should aim to be energetic, humble, both constructive and critical, neither sterile nor credulous, accustomed to think before he acts and to act upon his conclusions. A third social benefit is conferred by the *applicability* of scientific knowledge to provide techniques for large-scale handling of matter, and hence for the improvement of the material conditions of life; properly used, this last function of science can confer real benefits, for example, by raising the life of the poor to a more tolerable standard.

This third aspect of the social function of science is (I submit) in danger of being emphasized to the neglect of the others, of no less importance. The discussion exhibits much goodwill and much concern for social justice, but not always, perhaps, an adequate knowledge either of the nature of science or of the nature of man and society. That science is pursued in the first place for its truth; that it cannot dogmatize about questions which touch on philosophy; that economics is not independent of ethics; that human nature demands culture, family life, and spiritual values, before material comfort—all these considerations are too often ignored. This tendency is lamentable. It would lead us altogether too close to the Nazi view of science (already sufficiently exposed in Nature), with its insistence on *Anwendbarkeit* and rejection of the notion of science as an effort to reach certain truths.

A more liberal view, which does not neglect the intellectual values of natural science, is widely held, but is unfortunately less vocal[1]. A greater attention to the notion of pure science, as an ordered study with its own principles and its own intrinsic modes of development, is needed as a corrective to the current one-sided development of views on the social function of science. The admirable leading article in Nature on "The Repudiation of Truth"[2], and a recent letter from Dr. J. I. O. Masson[3], will repay attention in this connexion.

E. F. Caldin.

Queen's College,
Oxford. August 24.

---

[1] See, however, Polanyi, "Rights and Duties of Science", Manchester School of Economic Social Studies, Oct. 1939, p. 175.

[2] Nature, **145**, 871 (1940).

[3] Nature, **145**, 855 (1940).

RESEARCH ITEMS

Size of Family in Tikopia

RAYMOND FIRTH continues his study of the seasonal rites of Tikopia ("The Work of the Gods in Tikopia", Vol. 2. By Raymond Firth. Monographs on Social Anthropology, No. 2. Published for the London School of Economics and Political Science. Pp. v+189–378+8 plates. London: Percy Lund, Humphries and Co., Ltd., 1940. 7*s.* 6*d.*) by completing his record of the monsoon ceremonies and following on with rites of the trade-wind which do not take place in the monsoon. In opening with the text and explanation of a *fono* or public address or proclamation formerly delivered at Rarokoka, he directs attention to a remarkable injunction on population which is included as its closing section. The problem of population seems to have exercised the minds of the people considerably, migration as a means of regulating overflow was barred by size and situation, and this led to a clear apprehension of the dangers of over-population and also to definite types of social mechanism for its prevention. In the *fono* the tendency, owing to human weakness, to over-population was recognized by an exhortation in indirect but clear language to practise certain methods in sexual intercourse to avoid conception, and the size of the ideal family was hammered home, namely, "one male and one female. That is the plucking of the coconut and the filling of the water-bottles". This was an allusion to the allocation of duties in a household in native theory of four individuals, husband and wife, with a son and a daughter, making for correct economic adjustment, without imposing too heavy a strain on food resources. The boy assists the father, doing the more energetic jobs such as climbing trees for coconuts, cutting thatch, etc., the girl helps the mother, especially in keeping the family water-bottles full. If the family is much larger there is an increase in consumption without a corresponding increase in the value of labour power. The alternative to family restriction appears in the *fono* as a query "will the person go and steal ?"

Bactericidal Action of Mould Products

IT has been known for many years that filtrates from moulds such as species of Aspergillus or Penicillium may inhibit the growth of many bacteria and in some cases show bactericidal properties. E. C. White (*Science*, 92, 127 ; 1940) is now investigating the nature of the bactericidal material present in *Aspergillus flavus*. Following on the experiments of Prof. A. Fleming, work carried out at Oxford (E. Chain, H. W. Florey, A. D. Gardner, N. G. Heatley, M. A. Jennings, J. Orr-Ewing and A. G. Sanders, *Lancet*, 239, 226 ; 1940) has now shown that the substance penicillin which was isolated from moulds is able to exert its influence *in vivo*. Penicillin is only very slightly toxic to mice and rats. It inhibits the growth of several strains of Clostridium *in vitro*. Mice given repeated doses of penicillin were protected against lethal doses of *Streptococcus pyogenes*, *Staphylococcus aureus* or *Vibrion septique*. Penicillin is probably a new type of chemotherapeutic agent and is of interest on account of its low toxicity to animals.

Origin of Frogs

A NEW and important coal measure amphibian from Mazon Creek, Illinois, is described by D. M. S. Watson (*Trans. Roy. Soc. Edin.*, 60 ; 1940) under the name of *Miobatrachus romeri*. A redescription of *Amphibamus grandiceps*, *Hylonomus geinitzi* and *Eugyrinus wilderi* and a comparative review of these and related forms leads the author to maintain the propriety of the group Phyllospondyli. This order contains four families—the Eugyrinidæ, the Branchiosauridæ, the Melanerpetonidæ and the Miobatrachidæ. These form an ascending series with the Eugyrinidæ linking up at an early stage with the embolomerous Labyrinthodonts at the one end and the Miobatrachidæ leading on to forms like *Protobatrachus massinoti*, which is an Anuran. Thus while the precise ancestry of neither the Urodela nor Apoda still remain in doubt, that of the Anura has been traced to a family of Phyllospondyli that arose from the Labyrinthodonts in early Carboniferous times.

Crustacean Larvæ

R. Gurney and M. V. Lebour ("Discovery Reports", 20 ; 1940) have described the larvæ of Decapod Crustacea belonging to the genus Sergestes that were collected by the *Discovery*. In two species of the genus the complete life-history was known from previous work. In certain instances peculiarities of the acanthosoma stage enable them to be linked with the mastigopus and so with the adults, but the differences between the elaphocaris and acanthosoma stages are so great that the complete life-history cannot be pieced together from preserved material alone. To overcome this and similar difficulties both authors spent a considerable time at the Bermuda Biological Station. The present memoir provides a description of thirteen species and a key for the determination of their acanthosoma larvæ.

Genetics and Plant-Breeding

J. B. HUTCHISON (*J. Genetics*, 40, 271–282 ; 1940) has discussed the influence of genetics upon plant breeding. He shows that the introduction of proper statistical methods and progeny-row testing greatly facilitates the work of the breeder and provides a more efficient selection method than mass-selection. Using examples from cotton breeding, the disadvantages of pure line methods are contrasted with the results achieved from selection of mixed populations and with the advantages of land races which although impure from the geneticist's point of view remain stable under the influence of selection of the plant-breeder and of the environment. In an accompanying paper, V. G. Panse (*J. Genetics*, 40, 283–302 ; 1940) provides methods for the analysis of quantitative characters which will be useful in plant breeding. $F2$ plants of hybrids between three cotton strains were grown in a randomized progeny trial. Ten plants of each $F2$ progeny were selected at random and an $F3$ progeny was grown from these in a particular randomized arrangement. It was found that plot differences partly affect the studied character, staple length, therefore the mean value of each plot must be taken into account when selecting plants for breeding. It is shown that it is preferable to select plants on the excess staple length over the mean length of the plot. The variance of the progeny may be split up into that due to genetic influences and that due to environmental influences. The variance due to genetic influences may be used to estimate the number of genes which are controlling the segregation of the character being investigated. The possible number of genes, however, is influenced by their dominance and other inter-relationships. Genetics systems may be set up to satisfy this requirement and thus the probable number of genes which control a particular character may be suggested.

Genera of the Pore Fungi

Mycological taxonomy presents many difficulties; it possesses no physiological exactitude, as in bacteria, and is much more at the mercy of varying critical standards of different monographers than almost any other systematic field. Progress must be made by ruthless revision of genera as knowledge increases, and Wm. Bridge Cooke has recently made such a contribution for the Polyporaceæ (*Lloydia*, **3**, No. 2, 81–104; June 1940. Lloyd Library and Museum, Cincinnati, Ohio). A historical survey of this section of mycological naming leads, through lists of synonyms and homonyms, towards a practical key to the forty-six genera which it is now proposed to recognize. Many of these have been created to accommodate the polypores of tropical America; but the British student of fungi will find his familiar genera sorted by characters which should be readily distinguishable.

Cornish Tin Mining

The beginnings of tin mining in Cornwall and the much-debated location of the Cassiterides are discussed by C. E. N. Bromehead in an article on "The Evidence for Ancient Mining" (*Geog. J.*, August 1940). There is sufficient evidence in the form of picks and bronze implements in ancient workings to justify a belief that tin was mined in the Bronze Age. At the time of Pythias, about 325 B.C., the tin trade was already in existence, tin being shipped to the Loire or Garonne and then overland to the Mediterranean. Indeed this trade probably was carried on so early as 450 B.C. Earlier than that, however, it is likely that the Phœnicians sought tin in Britain, perhaps so early as 1000 B.C., by which time certainly they had sailed through the Straits of Gibraltar and founded Cadiz. Contributory evidence is the discovery of Irish gold work of about 1200 B.C. at Gaza, and beads from Brittany of equally early date in the eastern Mediterranean. The Cassiterides, however, remain an unsolved mystery. Bromehead inclines to believe they were a myth designed to mislead contemporaries of the Phœnicians as to the whereabouts of the tin mines. He discards the Isle of Wight but gives a doubtful acceptance to St. Michael's Mount for identification with Ictis, from which the tin was shipped. It certainly is the kind of port which the Phœnicians favoured in other lands.

Earthquakes registered at Hong Kong

Valuable data is contained in the Royal Observatory Hong Kong monthly seismological bulletin for April 1940. In this, the time of occurrence of several important phases is given to the nearest second together with the period of the waves and their amplitudes. It appears that during the month 41 earthquakes were registered on the Milne-Shaw seismographs, two of the shocks being stated to be local ones. The two largest earthquakes were recorded on April 6 at 13h. 45m. 30s. G.M.T. with an amplitude of 11 mm., and on April 16 at 6h. 17m. 8s. G.M.T. with an amplitude of 8·5 mm. In the report there is no mention of microseisms. Perhaps the observatory is fortunate in not being affected by the phenomenon.

Magnetic Properties of the Transition Elements

F. Bitter, of the Massachusetts Institute of Technology, presented a paper on this subject at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The main objective of this cryomagnetic research was to provide information about electronic configurations and interaction energies in solids. First experiments have been on compounds and alloys of the transition elements chromium, manganese, iron, cobalt, nickel and copper. It is proposed to complete a general survey of these substances from 14° to 1,200° Abs. in large and small fields. By way of illustration, the properties of iron were discussed. α-iron, Fe_3O_4, one form of Fe_2O_3, FeS are ferromagnetic; γ-iron and hæmatite (Fe_2O_3) are not. The author's results on $FeCl_2$, $FeCl_3$, and on alloys of copper containing less than 1 per cent of iron in solution show strong paramagnetism with interesting anomalies at low temperatures. Also an alloy of gold containing 12 per cent of iron in solution, although it has a face-centred cubic structure like γ-iron, is ferromagnetic up to 230° C. (*Bull. Amer. Phys. Soc.*, **15**, 20; 1940). The theory of solids is sufficiently advanced to attempt at least a qualitative description of the above facts. Such an attempt can be outlined, starting with assumptions about the Fermi energy resulting from the application of the exclusion principle and about the Heisenberg exchange energy, and then calculating the properties of iron atoms in various geometrical configurations.

Atomic Weight of Iodine

The atomic weight of iodine is of special interest, for as iodine is a simple element a comparison of the physical and chemical scales may be made through this element with less uncertainty than in the case of a complex element. The accepted value of the atomic weight, 126·932, was found by Baxter from a comparison of silver with iodine. Hönigschmid and Striebel in 1932, by the conversion of silver iodide into silver chloride, found the appreciably lower value 126·917. Baxter and Titus (*J. Amer. Chem. Soc.*, 62, 1826; 1940) have now redetermined the ratio AgI : AgCl by heating weighed quantities of silver iodide in a current of chlorine until no further loss in weight occurred, and they calculate an atomic weight of iodine slightly lower than Hönigschmid and Striebel's, namely, 126·915. They point out that silver iodide above its melting point seems to be somewhat unstable in air and even in nitrogen, so that some slight uncertainty exists as to the exact composition of the fused material on which the analyses were made. In a second paper, Baxter and Lundstedt (*J. Amer. Chem. Soc.*, 62, 1829; 1940) also determined the ratio Ag : AgI as well as the ratio AgI : AgCl. It was found that when silver was fused on lime in an atmosphere of hydrogen (Richards's method) slight reduction of the lime occurred and the silver showed calcium lines in the spectrum. The value found is 126·915. It is pointed out that there is some uncertainty about the mass spectrograph value, but the figure 126·915 lies between the value 126·917 found by Hönigschmid and Striebel and the best mass spectrographic value.

ENERGY AND ENTROPY OF EXTENSION AND SPREADING OF MOBILE MONOLAYERS*

BY PROF. WILLIAM D. HARKINS, DR. T. FRASER YOUNG, AND EDWARD BOYD,
UNIVERSITY OF CHICAGO

THERMODYNAMICS reveals in two-dimensional systems a peculiar state of matter in which an extremely large amount of heat is required to increase the distance between the molecules by about thirty-five per cent without a change of temperature or of state. In three-dimensional systems at ordinary pressures these large amounts of energy are not used unless a change of state, as from liquid to gas, occurs.

In the period of the last fifty years, much work has been done on the pressure-area relations of mobile monolayers, that is films one molecule thick, particularly those of organic substances of the general type of pentadecylic acid, or on alcohol or amine, on the surface of water. On mercury or gallium the relations are undoubtedly the same, but the experimental difficulties when a liquid metal is involved are very great. If a barrier is placed between a clean water (or mercury) surface, and the same liquid covered by a film, a force acts on the barrier from the film toward the clean surface, and this force per centimetre is considered as the surface pressure (π). If the mean area per molecule of the monolayer is very large, as 100,000 A. of area (sq. A.), the film is a perfect two-dimensional gas. (Ten billion A. equal one square centimetre, or sixty-five million billion, one square inch.)

On compression this two-dimensional gas begins to change to a two-dimensional liquid (L_1) at an area of several hundred to several thousand sq. A., and is completely condensed to the liquid film at 40–50 sq. A. and a very low film pressure. Further reduction of area results in a rapid increase of film pressure, until the liquid (L_1) changes into a second liquid (L_2), which has very remarkable properties, in that it is at first very highly compressible, but becomes quite incompressible if the pressure is increased sufficiently.

At a molecular area of about 20·5 sq. A. the liquid film freezes. The remarkable fact found by the application of thermodynamics in the present work is that there is no latent heat involved in this freezing, so it differs greatly in this respect from what is found in three dimensions. Thus a kind of 'ice' is formed which requires no heat to melt it.

Thermodynamical equations have been developed, which make it possible to determine the change in either energy or entropy of these two-dimensional layers (third dimension of the order of a ten millionth of an inch) on expansion or contraction. Thus if the films are stretched (expanded) they take up heat. The work shows that when a solid film is expanded at constant temperature, and undergoes transitions from solid to liquid (L_1), from liquid (L_1) to liquid (L_2), and then to gaseous film, almost all the heat is employed in two changes of area. As in three dimensions, a considerable amount of heat is utilized in the vaporization of the liquid (L_1).

The remarkable departure from the behaviour of ordinary three-dimensional matter is that in two dimensions at constant temperature:

(1) No heat is required to melt the solid.

(2) Very little heat is required to expand the liquid (L_1) so long as its molecules stay packed about as tightly together as in three dimensions.

(3) There then ensues an expansion of this liquid film such that the intermolecular distance may increase by so much as thirty-five per cent. This occurs without a change of state, but nevertheless the heat absorbed is very great. For example, if the film consists of pentadecylic acid this extension of the film absorbs as much heat as is used in the evaporation of the same number of molecules of water at ordinary temperatures (11,000 calories per mole).

(4) In the more expanded liquid state (L_2) the heat of expansion of the film is moderately high, but only a sixth as much per unit area as in the peculiar state described in (3).

---

* Substance of a paper read at the annual meeting of the U.S. National Academy of Sciences held during April 22–23.

BRITISH STANDARDS INSTITUTION

IN a paper read on April 2 to the London Branch of the Association of Mining Electrical Engineers, the significance of the work being carried on by the British Standards Institution was discussed by Mr. Percy Good, deputy director of the Institution. He began by paying a tribute to the foresight of British engineers who laid the foundations of a movement, which has spread to all industries and into practically every country. In Great Britain it is established on a truly democratic basis of self-government. Each industry as a whole governs for that industry; but due regard is taken as to the effect of any proposed change on other industries. Insistence on agreement between the interests concerned before a standard is promulgated has as a rule resulted in wide acceptance.

The original standardizing committee grew to be a chartered institution with more than a thousand industrial and technical committees, the pressure for more standards being continuous. The fundamental principles which govern its operation are: (1) to prepare a standard only when those concerned with the production and use of the product and material in question agree that a standard is desirable; and (2) to issue a standard only if those chiefly concerned agree that a suitable draft has been produced.

The Council of the Institution offered the services of the Institution to the Government a few months before the outbreak of War. Considerable work, especially in connexion with war-time needs, has resulted in the issue of a special series of specifications prepared for the Ministry of Home Security (A.R.P. Department). The British Standards Institution owns certification marks as well as proprietary rights to the term 'British Standard'. Some important conclusions or principles have been reached which have been endorsed by all the constituent parts of the British Commonwealth, and have received some support in the United States, in places where a different view had previously been taken. These principles were being discussed with the European countries before the outbreak of war. It was desired to secure that certification marks of quality or performance to indicate conformity to a specification should be granted only to a recognized independent organization and not to one financially interested in the products it is desirous of marking. It was decided, also, that such marks should be used only under effective control. The B.S.I. considers it essential that any proving scheme should be on the basis of proving that the material conforms to a written specification, and should not be on the basis that the testing authority considers the material to be satisfactory.

The British Standards Institution believes that its present system has considerable possibilities and is proving a success. That system requires a maker, who is desirous of marking his goods with the B.S.I. certification mark, to maintain in operation a system of control during the process of production which will give assurance that the product always conforms to the specification. There are often safeguards and the scheme is found to add practically nothing to the cost of production.

War-time, with its restrictions, its price control, etc., provides the opportunity for eliminating those things, which accumulate and hang round an industry like a millstone. Everyone concerned with production should look into his own and his industry's ranges, and ask the B.S.I. to assist in the inquiry.

Mr. Good, in reply to Mr. W. C. Barry, said that technical proposals are referred to a committee which is expected to be rather commercially minded to ensure that the technical men's enthusiasm does not run away with them. In a number of cases, the representatives of a country have agreed to the acceptance of a proposal, but had said they could not change their national standard ; and so each of these countries reserved that freedom. Mr. C. Le Maistre (director of the B.S.I.), replying to a question concerning the publication of specifications in languages other than English, said that a good deal of translation is being done by the B.S.I. into other languages.

ORIGIN OF THE SUBMARINE VALLEYS ON THE CONTINENTAL SLOPES OF THE NORTH ATLANTIC*

By Prof. Walter H. Bucher,

University of Cincinnati

THE essentially 'mature' topography of the continental slopes is so fresh that it is either actively forming now or has been fashioned by 'yesterday'. Being a surface pattern produced by erosion on a slope formed by deposition, it must owe its origin to a set of circumstances that either appeared for the first time or recurred after an absence sufficiently long to allow substantial progress of the sedimentation that produced the continental shelf.

Since the submarine slope topography extends to depths far greater than can be accounted for by removal of the water or vertical uplift of the shelf, the force or forces that caused the erosion must lie in the water of the ocean itself, that is, in currents. As the ocean is a standing body of water, the only currents capable of producing erosion on the continental slope are such as arise on the bottom through wave-motion of the water. Only such waves can have an effect on the sea bottom as have wave-lengths much greater than the depths at which effects are expected. Two types of such waves are known to oceanographers. Both are observed on the shore ; the one as the 'tide', the other as seismic sea-waves or 'tsunami'.

Recent measurements (Stetson, Shepard and Revelle, *et al.*) have proved the existence of currents at great depths of an order of magnitude consistent with tidal theory. These tidal currents consist of the back-and-forth movement which results from the elongated-elliptical path that characterizes the movement of the particles in water shallow compared to the length of the waves. But, while the tidal currents are strong enough to keep the submarine valleys free from sediment, they are not strong enough to produce them. Furthermore, the tide which results from extra-telluric forces has been an essentially constant phenomenon throughout geological time. It is, therefore, not an agent that can explain the submarine slope valleys.

The tsunamic waves, on the other hand, resulting as they do from telluric forces (gravity through subaqueous landslides caused by earthquakes and submarine volcanic outbursts), are precisely of that character. They are the shoreward expression of wave-motion that originates at the bottom of the sea and therefore involves the whole column of water. Their wave-lengths, measured in hundreds of kilometres, are such that their dynamics are those of waves in shallow water. Their energy is largely dissipated when they pass from oceanic depths on to the continental shelf which, where wide enough, offers effective protection to the coastline. Even on the coast, however, the wave-motion persists for many hours and half days.

---

* Substance of a paper read at the annual meeting of the U.S. National Academy of Sciences held during April 22–23.

The initial energy involved in waves that leave their records on gauges 8,000–16,000 km. away must be great since the three-dimensional concentric spreading of the wave-motion into motionless water involves much loss of energy. It is safe to assume that within a distance of many hundreds of kilometres from the centre of a disturbance the energy of the tsunamic waves is a multiple of that of tidal wave motion, and that it is therefore adequate to cause the erosion in the sediments of the continental shelf.

The earthquake records of the Atlantic Ocean show that crustal unrest is now causing earthquakes at a sufficient rate to account for the submarine erosion. An important earthquake or a submarine volcanic eruption a few times a century will produce currents that on the ocean floor are as effective as the few cloudbursts per century that carve the wadis of the great desert plateaux with which the submarine valleys have been compared.

But there is good evidence that both tectonic and volcanic activity were more intense in the recent geological past, especially along the mid-Atlantic ridge. The few small parts of the latter that stand high enough to rise above sea-level, such as Iceland or the Azores or diminutive St. Paul, bear abundant evidence to that effect. It may be inferred that the erosion of the continental slope is the counterpart to the intense tectonic and volcanic activity of Quaternary time to which the mid-Atlantic ridge owes its newer and bolder features.

The systematic study of the tsunamic waves, in which the Japanese have done already much excellent work, promises results not only of scientific but also of practical value. After the Grand Banks earthquake of 1929, for example, four trans-Atlantic cables broke at once; eight others went out of service at intervals up to thirteen hours after the earthquake. The curious circumstances of these cable breaks may find their explanation in the fact that much of the damage resulted from the cumulative erosive action of the currents set up by the earthquake.

THE FIRE ALARM SYSTEM IN THE UNITED STATES

THE request which has resulted in the development of the bulletin referred to below* on the fire alarm system in the United States originated at a convention of the International Municipal Association, held in Cleveland, Ohio, during August 30–September 2, 1937. It was made officially to the United States Office of Education, and H. A. Friede was appointed to co-operate with the United States Office of Education in developing the desired analysis of the proposed work.

In practically all cities of the United States having a population not greater than 30,000, fully automatic fire alarm systems are frequently used. In larger cities the functions to be performed by the fire alarm system are such as to require the exercise of a high degree of judgment on the part of the operator, especially when large fires or other emergencies occur. Up to the present time, the requirements of the men employed in fire alarm bureaux have received little attention from those who are promoting and operating training programmes for the personnel of the departments. In many cities the bureau is organized and operated as an independent unit of the city's entire programme of public safety. When this is the case, the co-operation between the chief engineer of the fire department and the superintendent of the fire alarm bureau should be close and effective. In cities where the fire alarm bureau is under the chief, full confidence should also prevail. In some cities the fire alarm bureau is responsible not only for the operation of the fire alarm system itself, but also for the police telegraph and the municipal telephone and radio communication systems, through which all fire and police stations, and police and fire department motor-cars may be reached in any desired combination, with practically no delay.

The two principal bases for the rating of responsibilities show (1) the degree to which specific responsibilities are delegated and (2) the degree to which each responsibility involved represents trouble, difficulty or worry. A practical and simple method of rating responsibilities from this point of view is illustrated by means of a graph. An arbitrary scale from 0 to 10 is used. A rating of 10 on this scale means that the responsibility is as completely delegated as it can be, whilst a rating of 0 indicates that the superintendent believes that he cannot delegate to anyone the responsibility for doing that which is necessary in order for him to discharge the duty satisfactorily.

In fairly large cities, there are four men in each of the following three classifications: chief operator, assistant chief operator and telephone operator. This makes it possible to have three shifts, with an extra man for each job available to take care of the work in cases of absence due to sickness, vacations and leave. To the fire alarm operator, technical and operating proficiency in the handling of radiotelephone equipment is essential, seeing that in most cities he is called on to operate the radiotelephone equipment. A knowledge of the geography of the city, similar to that required of the fire alarm operator, is also important for the telephone operator. The man on this job should make every effort to perfect his knowledge of the city and of all its important details while serving in this position and awaiting promotion to the assistant chief operator's job. Analysis charts are given of the various kinds of knowledge which those filling junior posts are supposed to have.

When it appears necessary to provide some training to secure greater efficiency of operation, the mistake is often made of setting up programmes of a more or less general character. As examples of this, mention is made of a general course of instruction in the principles of electricity or a series of lectures for fire alarm personnel on the history of the development of fire alarm systems. The kind of information that is really useful to the operatives and to the station is given in appendixes illustrated by clear line diagrams. These deserve special study by everyone interested in fire alarm stations, and clearly indicate the trend of future development.

---

* The Fire Alarm System: an Analysis of the Work of the Fire Alarm Bureau, with a Discussion of the Problems of Training likely to be Encountered. By Frank Cushman and H. A. Friede. (U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 207. Trade and Industrial Series No. 58. (Washington, D.C.: Government Printing Office, 1940.) 15 cents.

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, SEPTEMBER 28, 1940 No. 3700

MORAL ISSUES OF THE WAR

MAZZINI'S specification for bayonets that they should have ideas at their points is now seldom referred to, but the value of this stipulation has been proved in many campaigns since those which led to the liberation of Italy. Under the conditions of totalitarian warfare, its importance indeed is enhanced, not merely for the armed forces but for also the whole population. Under the strain of intensified air warfare and the comparative inactivity to which the large forces at present in Great Britain are subjected, if morale is to be maintained, endurance fortified and fighting efficiency enhanced, we must see to it that the rank and file are afforded the fullest opportunity for recreation and mental stimulus, and that at the least they have a clear understanding of the cause in which they contend and the part they themselves have to play.

Indeed it may be said that the need to-day is for something more than ideas. We are resisting, for the most part alone, a tyranny which has repudiated and trampled under foot all the noblest and enduring values of European civilization. Fundamentally, this is a struggle between diametrically opposed ideals or ways of living, and in the intense strain which the conditions of modern warfare impose on the whole population, the inspiration which a great and enduring ideal can give may well sway the issue by the fortifying influence it can have on morale.

From this point of view alone it is difficult to over-stress the importance of a clear understanding of the issues involved in this struggle, and what success or failure means to each one of us. The admirable new series of Macmillan War Pamphlets are well designed to serve this purpose*. In contrast with the well-known Oxford Pamphlets on World Affairs, which deal more with concrete and special technical problems, they are concerned essentially with the moral and spiritual issues. They aim at reckoning our own liberties and contrasting this freedom with the bondage of our enemies ; they probe the Nazi attitude to the Christian faith and they seek to examine and appraise the things for which we are fighting.

Not all the six pamphlets which have so far appeared are of equal merit. One or two of them are scarcely lucid enough to make the wide appeal that is the purpose of such a series, and err through intruding too much detail. There could, however, scarcely be a better statement of the issues in respect of freedom than the first pamphlet by Mr. A. P. Herbert. The struggle is between freedom and slavery, nothing less. A victory for Hitler would mean the spread of despotism and darkness : the victory of the Allies will mean the survival and the spread of light and liberty not in Europe only but wherever the sons of Adam dwell.

Mr. Herbert's succinct but searching analysis of what we understand by our liberties, with its fundamental concept of the value of the individual, ranging over the whole field of Parliament and Press and their responsiveness and sensitivity to public opinion, and its trenchant comparison with conditions in Germany, is indeed a stimulus to the lukewarm and half-hearted, and more than justifies his contention that there cannot and should not be neutrality in this War. We must either stand up in defence of freedom of thought, of speech, of worship, of Press and Parliament, with all that their continuance means in science, in art, in literature and music, or betray all that great moral, spiritual and intellectual heritage that has come to us from the past.

---

* Macmillan War Pamphlets. Let There be Liberty. By A. P. Herbert. War with Honour. By A. A. Milne. The Crooked Cross. By Dr. A. S. Duncan-Jones. Nazi and Nazarene. By Ronald Knox. When I Remember. By the Right Hon. J. R. Clynes. Nordic Twilight. By E. M. Forster. (London : Macmillan and Co., Ltd.) 3*d.* net each.

To recognize that we are the bearers of a noble trust and high responsibility is indeed heartening in days of trial. Mr. Milne's "War with Honour" aptly follows in the same theme and strikes with convincing realism into many of the pacifist arguments which seem so far removed from the world in which we find ourselves to-day. Mr. Milne points out that there are in theory three possibilities: the victory of Britain; the victory of Germany; or peace without victory. The third possibility, whether it involves leaving Hitler in possession of what he has already won, which is tantamount to a German victory, or in possession of no more of German Europe than is rightfully hers, which would be a British victory, is a wholly ineffective starting-point for the elimination of war.

Mr. Milne contends, therefore, that the only hope for the establishment of peace as desired by the pacifist lies in a victory for Britain. We have reached, he considers, a stage in human progress when the vast majority of the peoples of the world are pacifists, realizing alike the futility and the increasing barbarism of war. In a democratic country the main body of the people marks the stage of civilization which that country has reached, and for this reason offers a safeguard for peace which cannot be offered by an autocracy where the individual gangster may be the autocrat.

Mr. Milne frankly admits that the emergence of Hitler has invalidated all that he previously wrote about peace and war in "Peace with Honour". He affirms his conviction that if unresisted the abomination of Nazi rule will spread over and corrupt the whole world, and that in such a Nazi world there can be no place for decency, honesty or humanity. No man of courage, intelligence or imagination, no man who has a kindly thought for his neighbour or compassion for the innocent, no lover of truth, of beauty or of God can find a place in that world. It is this conviction that leads him to assert that it is the duty of mankind to reject such a world as much as it is the duty of a community to reject gangster rule. Only when this has been done by the use of force can civilization resume its march.

No less passionately in "Nordic Twilight", Mr. E. M. Forster affirms his belief that if the Nazis won they would destroy our civilization, and he points to the blank faces of German soldiers and airmen in any close-up photograph as showing that they have been cheated of their inheritance by a perverted education, and ruined mentally so that they may better spread ruin. Convincingly Mr. Forster shows how achievement in art and literature, in science and philosophy, is linked up with freedom of personality and expression. Already before the War German contributions in these fields were deteriorating because her culture had been allowed to become governmental. It was no longer genuinely national and capable of contributing to the general good of humanity.

The tragic picture which Mr. Forster draws of the way in which Germany's great cultural heritage has been violated by Nazi rule and its expression suppressed is paralleled by one of what is already being done to the culture of occupied or conquered countries, and a forecast of what might be done to our own if Germany should win. The picture demonstrates the impossibility of coming to terms with Hitler. A peace resulting from a Nazi victory would merely mean that Germans would no longer be killed, but they would go on killing others until no one survived to criticize them.

In the world domination thus achieved there could be no culture and no creative genius, for in their brutality and destruction the Nazis are destroying their own life. The passionate understanding which is at the heart of creation, no less than the calm use of the intellect—these are what the Nazi regime atrophies and destroys; to-day they are in the hands of the democracies to defend. It is the whole order of life that is based upon the dignity and eternal value of the individual human soul that is at stake, and these pamphlets well supply an interpretation of the issues and an understanding of what is involved that cannot but be heartening in one of the sternest hours of the struggle.

Mr. Forster closes on a note that harmonizes with those struck in two other of the pamphlets, in which the Dean of Chichester and Monsignor Knox describe the struggle inside Germany of the Protestant Church, the Confessional Church and the Roman Catholic Church against Hitler. Both alike lay bare the Nazi purpose of the eradication of Christianity altogether, and if at times these two pamphlets may seem a little too detailed for the general reader he can be left in no doubt as to the virulence of the campaign of this new paganism against the Christian Church as such. Such a reader may well marvel at the divisions of the Church which permitted Hitler in his usual way to play off one against another, but he may also wonder whether at last the realization that all the enduring values of Christianity, the traditions and thought which have so enriched the culture and civilization of Europe are at stake, may not in the face of a common peril effect a reconciliation and an understanding which are long overdue.

Mr. J. R. Clynes strikes a different note. The case for democracy against totalitarianism does not rest alone on moral and spiritual values. We are too apt to forget that democracy has a record of material progress and of the redress or removal of social injustice which no dictatorship can approach. It is to the revolution in social conditions which he has witnessed in his own lifetime that Mr. Clynes directs attention. In the vivid picture he gives in the pages of this pamphlet of the way in which conditions have changed over the whole field of education and child welfare, of industry, of unemployment and of housing, he does not conceal the fact that we have still far to go before we can rest content. None the less it is a heartening picture he draws of a silent social revolution which is still going on, giving a new sense of security and a rising standard of health and living, and in the reconstruction to follow the War should be accelerated.

Under our democratic institutions there have been indeed solid and revolutionary gains in a single lifetime. Even from a material point of view alone there are rights and privileges which we have won for ourselves and which it is an honour and a duty to defend. Built up on ordered freedom and reason and a respect for human rights and the individual soul, this civilization of ours must be upheld by every means that is just and right. To surrender one inch to the claims of Hitlerism is to endanger not merely the liberties which are the basis of all that is noblest in our cultural and spiritual heritage but also all that has been built up in the social sphere.

These pamphlets, appearing at a time when the struggle is being intensified and fiercer demands are made on our powers of endurance, are admirably calculated to fortify our resolution by the lucid way in which the issues are set before us. The choice is indeed between a victory for the enduring values of our civilization or a slavery and barbarism to which the pages of history can offer no parallel. In the heat of the struggle it is well indeed to be reminded of the greatness of our responsibility, of the solid achievements which form part of our heritage, and to glimpse something also of the possibilities of adding yet more splendid pages to that record when this present threat to the whole human race has been once and for all overthrown.

BIRDS OF BRITAIN

The Handbook of British Birds

By H. F. Witherby (Editor), Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Vol. 4: Cormorants to Crane. Pp. xiv + 461 + plates 93–125. (London: H. F. and G. Witherby, Ltd., 1940.) 21*s*. net.

THE fourth volume of the "Handbook of British Birds" is fully up to the high standard set by the previous three volumes. The birds described in the present volume are the shags, cormorants and gannets, the petrel family (including the fulmar and the shearwaters), grebes and divers. There are full accounts of the waders, such as curlew and whimbrel, the godwits, woodcock and snipe, red-necked phalarope, turnstone, dunlin and lapwing, dotterel and golden plover, greenshank and redshank, stone curlew and oyster catcher.

Since volume 3 was produced, the authors have suffered a heavy loss by the death of the Rev. F. C. R. Jourdain, one of the most learned and distinguished ornithologists of his time. In the words of the editor of the present volume:

> "It is deeply to be regretted that Mr. Jourdain, who took such an intense interest in this work, was not spared to see its completion, but he has left most careful notes and records from which can be drawn the accounts of the remaining species.
>
> "For this work we are glad to be able to say that we have been promised the co-operation of Mr. W. B. Alexander, Director of the Edward Grey Institute of Field Ornithology at Oxford, who with the consent of the University Committee for Ornithology has kindly undertaken the completion of the 'Distribution Abroad' sections for the present volume and will write both these and the 'Food' sections for volume v. Mr. Alexander's

special knowledge of both of these subjects will be invaluable, and Mr. Jourdain's notes and records will be available for his use. Further, we are promised the same help as before in revising—by Mr. H. G. Molineux for 'Distribution Abroad' and by Professor G. D. Hale Carpenter for the insects in the 'Food' sections.

"For the 'Breeding' sections we have available the elaborate and beautifully arranged notes which Mr. Jourdain had compiled with the utmost care over many years. From these Mr. Alexander will draft the sections, and assistance in revising has most kindly been promised by several specialists in various branches of the subject."

Each bird—even the rarest and most casual visitor to the British Isles—is carefully and minutely discussed, and its habitat, field characters and general habits fully described. Its call notes and song are reproduced; its display and posturing are recorded; its nesting, food, distribution and migrations are chronicled, and the appearance of the bird itself is carefully described (male and female, nestling and immature bird).

In the admirable treatise on the oyster catcher, it might perhaps have been added that, at its nesting sites along Highland rivers, the parent birds feed their young, chiefly in the evenings, on large worms, which they bring in on the wing from considerable distances. It is interesting, too, that at its inland haunts the oyster catcher nests often in fields of growing oats, or rye grass, or even on the crowns of furrows where potatoes and turnips have been planted. I have often seen the eggs laid in short heather, and on several occasions the nest has been found between the metals on the main line of the Highland Railway and of the Caledonian (now the London, Midland and Scottish) Railway. Another interesting point about this handsome and attractive bird is that along the east coast of Scotland it is scarce as a nesting species, but nests commonly inland, whereas in the west it nests commonly at the margin of the tide, but is a scarce nester inland.

Under the "Distribution" of the oyster catcher the inference is drawn that this handsome bird has only in recent years nested inland in Northumberland, but my wife tells me that, so far back as 1908, a pair used to nest near her home at Otterburn on a shingle bed on the River Rede not far from its head waters.

In the account of that splendid Highland-nesting bird the greenshank, I would say that the call-note is more musical by far than the call-note of the redshank. The description of the greenshank's song, which my wife and I heard under memorable conditions, can scarcely, in our opinion, be described as "a rich 'rü-tü, rü-tü, rü-tü' ". The song has *two* distinct whistled measures. After hearing the song, I wrote down the words which conveyed it best to my mind: "teuchi, teuchi, teuchi; clever, clever, clever". The two measures were repeated without pause and with tremendous vigour and excitement for upwards of half an hour while the songster flew swiftly backwards and forwards so high as to be scarcely visible to the unaided eye. The sombre sky and the old pines, motionless in the windless air far below that aerial songster pouring out a flood of wild music, will not readily fade from my mind. I recall that Viscount Grey of Fallodon mentioned to me on one occasion that his great desire was to hear the song of the greenshank, but that wish was not to be gratified—and indeed it is my experience that the greenshank rarely sings.

In the account of the distribution of the lapwing, it is mentioned that in the Highlands it nests to 1,800 ft. or higher. In the early summer of 1939 my wife and I found this bird, usually associated with the low country of agriculture, nesting among the western Cairngorms at an elevation of 2,800 ft., and from observations made during that summer I have no doubt that in this district the lapwing is penetrating much farther into the hills than it has done at all events during the last forty years.

As well as containing 455 pages of closely written (yet clear and legible) letterpress, the volume under review is enriched by 33 pages of coloured plates of birds delicately portrayed in flight by that well-known bird artist J. C. Harrison. In addition to these plates, there are valuable maps constructed by that distinguished young ornithologist J. Fisher, showing, among other things, the distribution of nesting gannets in 1939 off the coasts of Britain and Eire; the breeding colonies of that mysterious yet fast-spreading bird the fulmar petrel; and, still more ambitious, the world-breeding distribution and oceanic range of the same species.

A. Landsborough Thomson, well-known son of a distinguished father, contributes a valuable map to show the localities (often in far-distant countries) where gannets, ringed at British nesting stations, have been afterwards discovered, and it is interesting to know that the young gannet often wanders south as far as the tropics during the first autumn of its life. Among other maps to be noted is one by W. B. Alexander to show the British nesting distribution of the woodcock, and there is also a valuable map by E. P. Leach to illustrate, from the records of ringed birds, the migrations of the lapwing.

No one who is interested in birds can afford to be without this volume and the three which have preceded it.

S. G.

GENETICS AND THE STUDY OF DEVELOPMENT

Organisers and Genes

By Dr. C. H. Waddington. (Cambridge Biological Studies.) Pp. x + 160 + 2 plates. (Cambridge: At the University Press, 1940.) 12*s.* 6*d.* net.

THE student of heredity is confronted with two different groups of problems. The first group, including such questions as: 'Why do two white mice produce another white mouse, but not a black or a brown one?' has been answered, at least up to a point, by the geneticists. The second, typified by such a question as: 'Why do two mice produce a mouse, and not a rabbit, a mass of Protozoa, or a sarcoma?' has been answered much less satisfactorily. Genetical results have great practical value in the fields of agriculture, eugenics, and evolution, even if they are not applied to the study of development. But genetics will remain a somewhat isolated branch of biology until this is done.

So far the most systematic attempt to link up genetics and developmental physiology has been that of Goldschmidt. However, just because Goldschmidt has been a pioneer, his theories require careful criticism. It is perhaps impossible to go as far as he had gone without sometimes losing one's way. We can, therefore, welcome Waddington's monograph, which attempts to link up genetics and embryology from a somewhat different point of view from Goldschmidt's.

The first five chapters are a summary of the causal analysis of development which has grown up from the work of Spemann. Then follow two chapters on the action of genes, and the remainder of the book is concerned with the integration of the data of embryology and genetics. Geneticists will find Waddington's classification of the kinds of localization of gene effects, and of the types of genic interaction, in Chapter vi, particularly stimulating, though it is not certain that his terminology will be finally adopted. The discussion would have been still more valuable had he given more weight to data of plant genetics, such as Anderson's account of the interaction of the gene causing leafy bracts with those controlling leaf shape in *Primula sinensis*, which offers a close parallel to Waddington's account of the interaction of the genes for aristopedia (leg-like antennæ) and those controlling leg development in *Drosophila melanogaster*. Waddington's account of the development of the wings in mutant forms of this species differs substantially from Goldschmidt's, and until this vexed question is settled, a final judgment on the validity of some of his theories is impossible.

One of the central ideas in the book is the "epigenetic landscape". Development may follow a normal track symbolized as a river valley, or any of a number of branches which diverge from it at different points, and into which development may pass as the result of an appropriate stimulus at a suitable moment. Intermediate paths are more or less completely excluded. The main valley is broad and shallow in its early stages when regulation is possible, but the later stages are sharply defined. Like other symbols in biology, I expect that this one will prove valuable for a time, but may later be rather misleading.

On the whole, however, the book is distinguished by a critical discussion of possibilities rather than a formulation of new theories. It will be indispensable to workers who are engaged in research on developmental physiology or genetics, but will prove rather indigestible by students preparing for an examination or lecturers who are rapidly preparing a course.

The last chapter is devoted to a discussion of theoretical problems, and again is slightly disappointing. After describing Bohr's theory of complementarity in its application to biology, Waddington states that "although there are undoubted technical difficulties in performing a full physico-chemical analysis on biological entities without killing them, there is no theoretical reason why this should always be so". Is this quite fair to Bohr? He at least thinks that there is such a reason, and his opinions deserve consideration. In the same chapter an unnamed dialectical materialist (perhaps Lysenko) is credited with the view that the Soviet system has affected the chemical structure of human genes. It would surely have been well to give a reference for this theory. Undoubtedly, the Russian revolution has affected human genes in many ways, notably by breaking up inbred village communities, and thus reducing the frequency of rare recessive homozygotes, and the amount of selection against them. In the next paragraph dialectical materialism is praised.

In fact this chapter exhibits a critical mind in search of a satisfactory philosophy, and is of interest for this reason. I should welcome a book by the author on philosophy in relation to biology. But I am not so sure that the discussion sheds much light on the parts played by genes and organizers in development.

Perhaps it is inevitable that such a book should be incomplete in many respects. But those who buy it as a report on progress in a most interesting field will not be disappointed.

J. B. S. Haldane.

SCIENCE AND CRIME

(1) Forensic Chemistry

By Henry T. F. Rhodes. Pp. viii+214. (London: Chapman and Hall, Ltd., 1940.) 12*s*. 6*d*. net.

(2) Poisons

Their Isolation and Identification. By Frank Bamford. Pp. viii+344. (London: J. and A. Churchill, Ltd., 1940.) 18*s*.

(1) THIS small manual has for its objects, first to collect together information now widely diffused throughout criminological literature, and secondly, to outline the manner in which the practice of forensic chemistry is conducted in a forensic chemical laboratory.

The book is divided into two parts. Part 1 deals with the application of chemical methods to the identification of the person, and Part 2 is related to the application of chemical methods to the proof of the corpus delicti. With regard to the question of identification, such subjects as skin prints, the composition of sweat, the chemical development of skin prints, occupational dust, its classification, collection, sources, examination and the interpretation of results are dealt with. There is short allusion to the now very important subject of blood-grouping and a note on the possibility of grouping seminal stains, a procedure which has now been fairly extensively developed. In a short chapter on bloodstains, emphasis has been laid on the preliminary tests for blood, and certain crystalline tests are mentioned without reference to the most frequently used hæmocromogen crystal test. Spectroscopic and serological methods are omitted. The treatment of the examination of seminal stains is dismissed with considerable brevity.

In the second part of the book, the chemical examination of firearms and explosives and the chemical examination of questioned documents are given prominence, and these may be regarded as the best chapters. The examination of counterfeit money is also dealt with.

The concluding chapter is devoted to the field of toxicology; it covers some forty-one pages and provides a superficial introduction to this large and highly technical subject.

The difficulty of the reviewer was to determine the class of reader for which the book is intended; nevertheless, it is sure to find a large number of readers whose work and interests require information with regard to certain aspects of forensic chemistry.

(2) Bamford's recent work is an excellent laboratory manual which will be welcomed by all chemists and toxicologists whose work brings them into contact with cases of poisoning. The book is essentially practical in character and the author has included his very comprehensive experience in tried and trusted laboratory methods. The writer of this review has been afforded numerous opportunities for observing the wide scope of Mr. Bamford's work as late director of the Medico-Legal Laboratories in Cairo, which are responsible for the investigation of all medico-legal cases arising from a vast population over a very wide area.

Within the compass of some three hundred and forty-four pages, a wealth of highly valuable material has been marshalled and it covers a wide field between the introductory chapter, devoted to the question of organization and equipment of a modern laboratory, and the concluding chapter, which deals with the drugs of addiction and includes opium, its alkaloids, cocaine, nutmeg, the atropine group, gelsemine, chloroform, ether, petrol, chloral, the barbiturates, fly-agaric, the anhalonium drugs and also hashish, which receives a generous contribution. Early in the book, a classification of poisons is provided and thereafter each group is dealt with. The chapters dealing with volatile poisons, common metallic poisons and other metals are well written. In the first of these, the alcohols receive a proper place and the processes of Nicloux and of Widmark are fully described, while both the Mitscherlich and Blondlot-Dusart tests are included under phosphorus. Among the metallic poisons, arsenic receives full treatment, and the wide experience of the author is clearly reflected. His allusion to the presence of 'normal' arsenic within the human body is of value, since this is a question which arises, from time to time, within the courts of criminal law. The detection and determination of organic arsenical compounds, since special methods for their investigation are sometimes necessary, are included.

Some twenty-seven pages are devoted to the subject of corrosive acids and alkalis, the poisonous salts of alkalis, and the halogens. An outstanding feature of the book is the author's treatment of the alkaloids and his systematic scheme for their identification, in which are embodied the results of a large amount of original work.

The Stas-Otto process, one of the most difficult of analytical problems, is described in both a concise and convincing manner. Identification of the barbituric acid derivatives is included in the contents, and among the miscellaneous poisons, the toxalbumens, poisonous plants and fungi, the sulphonamide drugs, together with the fur- and hair-dyes, are to be found. A useful table provides the various reactions of the different fur-dyes. It is a matter of widespread regret that the death of the author of this excellent handbook precluded him from seeing the finished product of the subject-matter on which he had lavished so much care and patience. His son, H. F. Bamford, and Dr. G. D. Elsdon are to be congratulated on their final preparation of the book for the press. The publishers have maintained their usual high standard in the production of this volume, which is well indexed.

The reviewer fully concurs with the concluding sentence of the foreword by Prof. Sydney Smith, to the effect that this book is the product of a highly skilled specialist in toxicological analysis and that it can be recommended with complete confidence to all those whose work entails such analysis.

J. Glaister.

CONSERVATION OF THE SOIL

Soil Conservation

By Hugh Hammond Bennett. (McGraw-Hill Series in Geography.) Pp. xvii+993. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 40*s*.

In many countries distant from the storm centre of world politics the perpetual war between man and Nature has in the last two decades reached an acute phase. The maladjustment between an established form of human society that had transplanted itself to the unwonted environments of the New World had culminated in the remarkable phenomenon of soil erosion, the widespread disappearance of the very basis of life itself. Nowhere did the capitalistic form of society that colonized the world from its homeland in Europe take firmer root or grow more lustily than in the United States, and nowhere has soil erosion been more virulent, or is having such far-reaching effects on the structure of society.

During the last ten years a powerful reaction against the destruction of the soil by an agriculture inappropriate to the environment has set in in the United States, and has already produced a very extensive literature. This latest book, by the Chief of the Soil Conservation Service, is significant in that it stresses, both in its title and throughout the text, the conservation rather than the destructive aspect of the subject—significant in showing that the United States are passing out of the exploitative into the constructive phase of their agricultural evolution. Dr. Bennett is especially concerned with the human side of the soil-conservation problem, that is, with the correct adjustment of the agricultural basis of society to the natural environment. He believes that the means and knowledge for this adjustment are available, but the task must be tackled on a nation-wide basis and according to an all-embracing nation-wide plan of reconstruction. Dr. Bennett is a democrat and individualist, and he recognizes the strains that must be set up in the body politic when the demands of the land for a pre-determined form of agriculture come into conflict with those of the people for a continuance of the freedom of action they have hitherto enjoyed.

So far, however, these strains have scarcely been felt. When the seriousness of the erosion question was realized by the nation the immediate task was to stop erosion, and it has only been within the last two or three years that the more difficult task of reorganizing the agricultural basis to prevent the soil exhaustion that precedes erosion has been taken in hand.

In the first part of his book Dr. Bennett describes the various manifestations of erosion; in the second and larger part the measures now being taken in the United States to check erosion and to rebuild fertile soils which will not erode. Measures to check erosion are mainly mechanical, designed to prevent water from running downhill or to curb the force of wind blowing over exposed land, but their co-ordinated application involves a revolution from an exploitative agriculture to systems based upon the inherent properties of the land. It is here that soil conservation gains a wider and more human interest. Dr. Bennett shows very clearly how a biological and ecological concept of soil conservation has developed out of the social problems that have arisen from the increasing application of mechanical measures for stopping soil erosion, and at the same time how the physical phenomenon of erosion can be traced to social and historical causes.

Although the book is entirely about the United States, much of its matter has universal validity. It is excellently planned, and more than 350 vivid illustrations complete the most comprehensive and authoritative treatise yet published on this urgent problem of the present day.

G. V. Jacks.

ANNUAL REPORTS ON CHEMISTRY

Reports of the Progress of Applied Chemistry
Issued by the Society of Chemical Industry. Vol. 24, 1939. Pp. 756. (London : Society of Chemical Industry, 1940.) 12*s.* 6*d.*; to Members, 7*s.* 6*d.*

Annual Reports on the Progress of Chemistry for 1939
Vol. 36. Pp. 458. (London : Chemical Society, 1940.) 13*s.* net.

EACH year, when new volumes in these two series of annual reports on the progress of pure and applied chemistry are published, we realize that their appearance is an occasion of considerable moment; to chemists because they provide an opportunity for appreciating the significance of contemporary advances in fields abutting on those already under the worker's constant survey, and to others of scientific interests because they offer brief but authoritative reviews of very many important subjects now engaging the attention of researchers in chemistry and its intimately related sciences.

It has long been impossible for chemists to obey the late Prof. H. E. Armstrong's injunction to "read everything", and doubtless even abstract publications are read from cover to cover only by their editors; but here at least is a concentrate in readable form and, upon judicious selection, in assimilable quantity. While the reports on applied chemistry continue in most cases to present a compact yet comprehensive and heavily documented survey of the year's developments in numerous industrial processes based on chemical operations, those on pure chemistry have assumed the character of essays on recent progress in selected phases of chemical thought and experiment. Thus, for example, in the Chemical Society's volume an account is given of synthetic work on the steroids accomplished during the period 1937–39; the article on the structure of liquids is a sequel to that contained in the report for 1937; stereochemistry is surveyed over the past four years; while the reporters on nutrition are faced with the task of reviewing "about 6×10^3 new papers per annum", of which between one third and one half deal with the vitamins. The analytical section contains an account of the use of the microscope, and deals also with the analysis of dusts and smokes, including the collection of siliceous dusts of importance in the study of silicosis. A chapter on crystallography deals first with crystal physics (thermodynamics and structure), then with inorganic compounds, and finally with the structure of organic substances, including insulin. Another section is concerned with reactions in non-aqueous solvents, while in yet another, dealing with nuclear fission as a possible basis for a chain reaction, it is argued that in uranium containing ten times the normal concentration of the 235-isotope the capture of neutrons, although producing explosion, would not form an effective basis for the construction of a super-bomb.

In the volume devoted to applied chemistry one finds frequent reference to the incidence of the War on industry, with at least one encouraging declaration that research of an emergency nature has not yet been required, and certain interesting facts relating to the industrial resources of both belligerent and neutral countries are quoted. In relation to the fact that aluminium is usually manufactured from bauxite mined chiefly in France and the Guianas, there is a reference to the industrial possibilities of Indian bauxite from which 95 per cent of the metal is stated to be recoverable. Elsewhere one finds a plea for industrialists to enlist the sympathy of university professors in a much wider application of the idea of fellowships for industrial research; and one feels that there is plenty of such sympathy to be had for the asking. There are new natural sources of rubber stated to be worth investigation; aeroplanes assist the dispersal of noxious insects; a new safety glass is very strong and resistant. As an example of how an advance in one branch of applied chemistry raises new problems in another may be quoted the production of a new synthetic polyamide filament, Nylon, a substitute for silk; the new problems concern the dyeing of this near approach to a synthetic protein fibre.

There are heartening comparisons, for example, in respect of drugs, dyes, and fine chemicals, between the industrial condition in which Great Britain now finds herself and that which she suffered in 1914; and for this we must pay tribute to the immense amount of fundamental research which has been carried out during the intervening period. Indeed the dependence of industry on scientific institutions for the initiation and prosecution of such fundamental investigations is particularly emphasized in the opening paragraphs of the chapter on pulp and paper: "Most of the information about developments in the pulp and paper industry now comes from universities, state-controlled departments, trade research institutes, etc.; even the patent literature reveals little of what is going on in works and commercial laboratories. . . . It may be expected that the move towards centralised research on fundamental problems will continue in all countries, and that the rate of progress in any country will be closely related to the extent to which its research institutes are supported".

A. A. Eldridge.

TECHNOLOGY OF SOUND TRANSMISSION

Sound Transmission in Buildings
Practical Notes for Architects and Builders. By R. Fitzmaurice and William Allen. (Department of Scientific and Industrial Research.) Pp. viii+50. (London: H.M. Stationery Office, 1939.) 4*s*. net.

One might justly express surprise that a report under this title should deal with an acute social problem of this critical stage in our civilization. "The gramophone and the loud-speaker are undoubtedly the greatest source of difficulty in a modern building. Not only have they become almost universal but year by year they become capable of greater undistorted acoustic output and the tendency is for them to be worked at a higher level of sound intensity on account of the greater realism which can thereby be obtained," say the authors of this report. Their main concern is to show how the fundamental principles which have been found to underlie modern types of sound-insulated structure must be put into building practice if good-neighbourliness is to survive in the life of the modern city.

The work on which this was based was carried out at the National Physical Laboratory and the Building Research Station. It began with simple cases of sound transmission through walls and floors, but investigations on the elements of a building structure taken separately proved insufficient; interaction between walls, floors, etc., proved of the first importance. Units were built up on steel frames at the Building Research Station for this purpose and tests were also made of actual buildings. The conclusion reached is that so long as rigidly connected structures are used, no overall insulation to air-borne sounds can be expected to improve on that afforded by a 9-in. brick wall.

Suggested practical constructions are given in this book to show how noise-insulation technique stands to-day. The subject is dealt with under three headings. The first section deals with the modes of transmission of air-borne and impact sounds, in which it is pointed out that though mass and rigidity of structure may stop the former, nothing but definite discontinuities can isolate the latter. In the second section figures are given in the form of simple nomograms to show the type of homogeneous construction which should be employed with a given external disturbance to give sufficient quietude for carrying out certain classes of occupation inside the building. These data are cleverly presented to avoid the usual tabulation of decibels or phons which might embarrass the architect unused to such technical terms. Three such figures are given: (1) for external air-borne noise; (2) for indoor air-borne noise; (3) for impact noise. The third section will possess the greatest interest to the practising architect and builder, for in it are given illustrative specifications in the application of discontinuous construction to flats, semi-detached houses, hospitals and offices. Experience gained in the construction of suspended ceilings and floating floors is placed at the disposal of those who will in the future be called upon to make use of it. No detail is too small to be overlooked; fireplaces, chimney-stacks and the plumbing fixtures are all designed specially to suit the construction, since these must be independent of the floating boxes of which the rooms virtually consist, and must be isolated from them in the outer shell of the building.

The authors claim that, armed with the information they give, it is possible to visualize a solution for almost any problem in noise insulation which may arise in connexion with building in the future. For example, it may be possible to do away with structural floors as separate elements and to use only floors and ceilings not rigidly connected to the shell. Buildings could then be constructed on a unit system, each story being separated from the next by a resilient pad. Although formerly it was thought that tie-rods were the weakest part, from the sound-transmission point of view, of a discontinuous structure, it has recently been found that wall ties of certain types used in cavity wall construction are quite effective insulators. These and other possible simplifications in structure will be tested at the Building Research Station.

The authors and publishers are to be congratulated on this book. There is bound to be a large amount of reconstruction—in the literal sense—after the War, and it is to be hoped that it may result in the application generally of the ideas here presented.

THEORY OF NUMBERS

(1) Elementary Number Theory

By Prof. J. V. Uspensky and Prof. M. A. Heaslet. Pp. x + 484. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 26*s*.

(2) Modern Elementary Theory of Numbers

By Prof. Leonard Eugene Dickson. Pp. vii + 309. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 18*s*. net.

(1) THIS is a systematic text-book on the elements of the theory of numbers, intended for beginners. The greater part of it deals with the usual elementary topics: divisibility, the H.C.F. process, congruences, and binary quadratic forms (but without the classical theory of reduction and equivalence). The proofs of the theorems are given in full and ample detail, and there are frequent numerical illustrations, and sets of examples for solution by the student. Most of these are quite straightforward, but there are several which strike one as distinctly difficult in relation to the text.

There are also three chapters of a less elementary character: one on Bernoulli's numbers, one on various Diophantine equations, and one on Liouville's method and the representation of numbers as sums of three and four squares. (Incidentally, in the first of these, the statement in words of von Staudt's theorem is not quite correct.) These chapters will naturally make difficult reading for students. The fact that they "contain some material not to be found readily in other texts" means that they are necessarily out of harmony with the rest of the book.

The book as a whole is very well written, though with a certain prolixity in the earlier chapters. An excellent minor feature is the provision of short historical and biographical notes on the mathematicians with whom various famous theorems are associated. The three appendixes on magic squares, the calendar, and card-shuffling, may serve to attract the student's interest and attention, but have no very intimate connexion with the subject-matter.

Probably the book will be of greater value to American than to English students. The printing is good, but the price is rather on the high side.

(2) The title of Prof. Dickson's book is perhaps not entirely appropriate. One part of the book is elementary but not modern, the other part is modern but not elementary, except in a technical sense. The former, consisting of the first four chapters (about 90 pp.), provides a concise introduction to the theory of numbers, one chapter being devoted to each of: foundations, congruences, quadratic residues, and binary quadratic forms. The rest of the book is an account of various topics, chiefly quadratic forms and modifications of Waring's problem, upon which Prof. Dickson and his pupils have worked in the last ten or fifteen years. Their work has resulted in simplifications of former proofs and extensions of former results, and the book provides clear evidence of the productiveness of the research school which Prof. Dickson has established at Chicago.

In the chapters on quadratic forms (Chapters v, viii, ix, xi, xiii), the main results proved are: Ramanujan's theorem (the first complete proof of which is due to Prof. Dickson), which enumerates those fifty four forms $ax^2 + by^2 + cz^2 + dt^2$ (a, b, c, d positive integers) which represent all positive integers; Legendre's theorem on the solubility of $ax^2 + by^2 - cz^2 = 0$ with x, y, z not all zero; Dickson's own theorem on forms $ax^2 + by^2 - cz^2$ which represent all integers; and Meyer's theorems on the solubility of $a_1x_1^2 + \ldots + a_nx_n^2 = 0$ when $n = 4$ or 5.

In two chapters (vi, vii) on cubes, the author proves Wieferich's result that every positive integer is representable as the sum of nine non-negative integral cubes, and extends the result to representation by $a_1x_1^3 + \ldots + a_9x_9^3$, where the a's have particular numerical values, or by $P(x_1) + \ldots + P(x_9)$, where $P(x)$ is one of an enumerated set of particular cubic polynomials. In a chapter entitled "Waring's Problem", he also proves Wieferich's theorem that every positive integer is representable as the sum of thirty-seven integral fourth powers. All the proofs involve some numerical computation. There is also a chapter (x) on sums of polygonal numbers.

In order to make the book practically self-contained, the author gives in an appendix a proof of Dirichlet's theorem on the existence of primes in a given arithmetical progression. Apart from some preliminaries on infinite series, due to Prof. W. T. Reid, the proof follows very closely that given by Landau ("Vorlesungen über Zahlentheorie", vol. 1, pp. 83–96).

The style is a strictly business-like one, and the author does not give much indication of the general theories which sometimes underlie particular results. The references to the history and literature of the topics treated are often inadequate. In the chapters on Waring's problem, for example, there is no mention of Hilbert or of Hardy and Littlewood.

It is not quite clear for what class of reader the book is designed. The ordinary student cannot be expected to make much progress beyond the earlier chapters. The expert will find it a convenience to have an elementary account of quadratic forms in three and four variables to which he can refer, but he is unlikely to be interested in the various modifications of Waring's problem, or in the introductory chapters. The book, however, will certainly be of great value to research students whose field is related to one of the topics dealt with. H. Davenport.

PREPARATION OF REPORTS

(1) Writing the Technical Report

By Prof. J. Raleigh Nelson. Pp. xv+373. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 16*s*. 6*d*.

(2) Industrial Surveys and Reports

By Prof. Walter Rautenstrauch. Pp. x+189. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 15*s*. net.

The literature available for the guidance of scientific workers in the preparation of reports of scientific and technical papers is already considerable, as a glance at the bibliographies contained in Soule's "Library Guide for the Chemist" or the "Manual on Research and Reports" issued some years ago by the Committee of Research of the Amos Tuck School of Administration and Finance shows. The bulk of this literature is of American origin, to which indeed the two present volumes are no exception, and it cannot be said that, whether in industry generally or in particular fields of science, the scientific worker has yet shown himself anything like as competent in his standard of presentation of the results of his work as is to be desired.

(1) Prof. Nelson's excellently written book, however, leaves no scientific worker with any excuse for failing to obtain a reasonable standard of proficiency in this respect. An outstanding weakness of many technical reports is failure to realize the reader's point of view or the purpose which the report is intended to serve. Prof. Nelson insists that the report is a document prepared for a designated reader or group of readers who need it for certain definite uses. This definition of the report is emphasized throughout the book, and with it emphasis is placed on the design of the report as a structural whole. These two conceptions dominate the whole argument and plan of the book. They are kept clearly in mind in treating of the need for classification and organization of material as a basis for writing and in the recognition of the shaping and determining effect of the objective on the structural characteristics of a report. The technical ideal of fitness for the purpose is as valid for reports as in the design of other structures qualified to carry their loads.

The first of the four parts of Prof. Nelson's book deals with the design of the report, the second with suggestions as to the form and style of the report, covering such matters as stationery and typing, use of words, abbreviations, tabulation, annotations, etc., while the third part deals with criticism of the report with the object of helping a writer to examine his own work with a view to continual improvement. Throughout these parts Prof. Nelson's lucid writing is assisted by the free use of admirably selected illustrations. His points are ably and clearly made, and nothing but sheer indifference or laziness can account for poor reports from any scientific worker who takes the trouble to read this book. Outstanding not only for the lucidity of its exposition but also for the numerous practical examples it contains and their lavish treatment and clarity, it is unquestionably the best guide to the writing of reports which has yet appeared. The careful explanation of the functions which the various features in a report have to serve, such as the introduction, the headings, summary and conclusions and the use of the paragraph in the design of the report are well worth attention even from the experienced writer. Prof. Nelson has earned the gratitude of all scientific workers who are concerned with the skilful, orderly and accurate exposition of the results of their work.

(2) Dr. Rautenstrauch's book has much slenderer claims on the interest of scientific workers. He gives us an excellent opening chapter on the general principles of report writing, in which many of the principles enunciated by Prof. Nelson are much more briefly mentioned. For the rest, the title of the book is misleading. The application of these principles is limited to investigations in financial matters and does not include the wider field which the term "Industrial Survey" would naturally suggest to those familiar with the reports of such surveys prepared by various universities, for example, in recent years at the request of the Board of Trade or the like.

R. Brightman.

SOCIAL AND TECHNICAL TRAINING IN WAR-TIME

ONE of the novel features of the present situation is the presence in Great Britain of an army of more than two million soldiers largely without the soldier's proper task of fighting. The maintenance of the morale and welfare of large bodies of inactive forces is a major problem which has been too much for many commanders in the past. The problems it raises for us already demand close attention and will become the more searching with the shortening of the days as winter approaches. We cannot ignore the classical examples of the demoralization of idle armies.

While this is true, the question of the Army welfare should not be approached purely from the negative point of view of preventing demoralization. There is a general desire among the public of the country to alleviate any discomfort or monotony with which the troops are threatened. This desire has received official recognition, and a prime responsibility of the Army Welfare Organization established last November is that of directing this goodwill into the channels in which it can render the most effective service. If this is wisely and efficiently done we may well find that, without impairing that valuable tradition of the British Army of the responsibility of the regimental officer for the well-being of his men, we have not only effectively combated boredom but also in so doing developed an even closer and fuller sense of comradeship between the citizen and the forces, which should prove an invaluable asset in dealing with the post-War problems of reintegration and reconstruction.

Looked at even from this point of view, the organization of welfare work will involve many problems if gross disparities in different localities are to be avoided, either through the varying interests and resources of the Territorial county associations and the needs or conditions of the troops in different areas. Nor should it be considered that the problem is purely one of providing entertainment or amenities or facilities for games or sport. The universities in a number of areas have already turned their attention to the educational needs of the troops in the areas they serve, by providing programmes of lectures. Such extramural work may well require wide extension as part of an organized attempt to see that the minds of those called to the colours do not stagnate or become set in service grooves.

The possibilities in this direction merit immediate exploration. Even if only a minority of the men desire these educational courses they deserve the best encouragement and some considered attempt to find the right kind of instruction. Moreover it should be remembered that in many areas the men will be well outside the normal radius of a university, and if the whole country is to be covered effectively some scheme of co-operation may well have to be devised between the universities themselves, as well as between them and the army welfare authorities. Steps are now being taken in connexion with this (see NATURE of September 21, p. 396).

Behind all such educational schemes, the provision of entertainment or sport, or of opportunities for pursuing hobbies such as gardening, carpentry, music, there is a deeper significance which should not be forgotten. If by using the goodwill and services of individual citizens or civil authorities already recognized, the War Office can find the gardens, the workshops, places for various kinds of music required, and in doing so encourage on the part of the citizen a keen sense of comradeship with his fellow citizens under arms, there is an equally important reverse side of the picture. The soldier in his turn may in the same process become the better fitted to take his place again in civil life after the War.

It is this sense of the possibilities which we have in such educational work or recreation activities of fitting men to take their place more readily and happily in the new social or industrial order to be established after the War that is all important. If we are really alive to the opportunities which confront us in this field and do not allow them to escape us, we may well find attention to what at the moment appears to be a secondary aim—that of preparing men and women to take their place efficiently and harmoniously in a new order—will also serve best the immediate task of eliminating boredom and preserving morale. The adaptability or flexibility of mind, no less than the wider outlook and the sense of social responsibility and ideal of service and fitness which are so important an element in training for modern warfare, are the same qualities upon which we must build a higher ideal and nobler conception of citizenship.

A like opportunity may well confront us in the training schemes for industrial workers for war needs which are being introduced by the Ministry of Labour. Whether we are concerned with the training schemes which are being initiated primarily to increase the numbers of highly skilled workers for the engineering factories for munition production, with the training of workers displaced from less essential industries or occupation for munition work at the lower levels of skill, or with the training of women,-the training cannot but contribute to increased mobility and flexibility of labour after the War. To the value of this as a national asset, reports of the Commissioners for the Special Areas testify.

It is well indeed that we should appreciate the long-term as well as the short-term advantage to the nation of such training schemes, for there are difficulties which are only likely to be overcome if the long view is kept carefully in mind and resolutely pursued. The experience gained in the Special Areas with the junior instruction centres and training schemes to meet local needs, even though these were limited to persons who had attained the age of eighteen years, shows that even on the worker's side there are prejudices to be overcome and personal or social obstacles to rehabilitation in the way. It is essential that the worker himself should be roused to a sense of the new and permanent opportunity now opening before him or her and become inspired with a new self-respect and sense of civic or social responsibility.

Nor are the obstacles only from the side of the worker. Training to the extent now demanded is beyond the resources of the Government training centres themselves, even if engineering employers respond freely to the Minister of Labour's appeal for the release of suitable men to become instructors in the training centres, the number of which Mr. Bevin hopes to extend from 19 to 40. Besides this there has been initiated, in association with the President of the Board of Education and the Secretary for Scotland, a scheme of short courses of training through the technical colleges, by which it is hoped to add at least a further 50,000 to the 100,000 trainees coming from the training centres.

With all this there must be the fullest co-operation of employers in the training arrangements being set up not only in garages, maintenance shops and other shops with unused capacity, but also in the factories already on War production, if we are to secure the maximum utilization of our man-power essential to supply our wartime needs. Here is indeed a problem demanding technical knowledge as well as wise administration and loyal co-operation on the part of the management if a full and rapid solution is to be obtained. The introduction of training programmes into a works or other organization is no simple matter, as is well shown by F. Cushman in his recent book*. For all the American jargon which it contains, many of those called upon to arrange such training schemes might do worse than consult this book.

Besides his analysis of the factors and principles involved in developing and carrying out a programme of training, Mr. Cushman emphasizes the fundamental importance of the attitude of the executive. Mr. Bevin has already indicated in no uncertain manner that there are quarters in which this still leaves very much to be desired. The Government does not, however, as yet appear to realize that the nation is in no mood to tolerate any failure to apply compulsion to deal with recalcitrant elements who impede the maximum development of our War effort.

If, however, there are numerous technical details in such training schemes which must be worked out by careful scientific study, the long-range view must still be kept carefully in mind. Efficient production demands not merely skilled or technically proficient workers, but also workers who are keen on their job and see its part in relation to the national effort. It is the conception of national service which lies behind the great response to the appeal to "Go to it" which has characterized these last few months.

For this reason alone our conception of training must embrace not merely technical fitness but social fitness also. Behind our training schemes there must be the planning which will ensure that immediate use is made of the skill of the trainees, that they are not kept waiting about for long periods while their skill and keenness both deteriorate. We must have clearly in mind the jobs for which we are training men and women, quantitatively as well as qualitatively.

Behind this short-term planning there must also be the more or less deliberate long-range planning in regard to the needs of the individual and of the community in the new order to follow the War. Such planning, even if little more at present than stimulating the ideal of service and citizenship, promoting adaptability and flexibility of mind and also skill, and the wise, sympathetic but determined handling of all those factors or intransigencies, whether in regard to the dilution of labour, professional privilege, co-operation in training schemes or the like, which no less in reconstruction than in this hour of peril are anti-social and inimical to the common weal, may well make the vital contribution to morale and drive which is all-important in a free community. If Mr. Eden and Mr. Bevin are alive to the wide opportunities which lie before them they may well make in these next few months a most significant contribution not merely to the winning of the War but also to the building of a new world. They will deserve the whole-hearted support of every citizen of vision and good will in their efforts to make full use of these possibilities.

---

* Training Procedure: a Discussion of the Problems encountered in Planning, Organizing, Operating and Maintaining Efficient Training Programs in Industrial, Business and Public Service Organizations. By Frank Cushman. Pp. x+230. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 12s. net.

THE TOTAL SOLAR ECLIPSE OF OCTOBER 1, 1940

BY PROF. F. J. M. STRATTON, O.B.E.,
UNIVERSITY OF CAMBRIDGE

NOT for the first time a European War has sadly interfered with plans for the observation of a total eclipse of the sun. European expeditions to South Africa and South America have all been necessarily abandoned. Four expeditions from Great Britain (from Aberdeen, Cambridge, Greenwich and London) have had to be given up, though some of the apparatus which was to have been used by the British parties have been sent out to South Africa for the use of parties from the Royal Observatory, Cape of Good Hope, and from the Radcliffe Observatory, Pretoria, the great mirror of which suffers one more long delay in completion and arrival. The only other expeditions likely to observe the eclipse—save local parties of university students and keen amateur astronomers—come from the Commonwealth Solar Observatory at Mount Stromlo, Canberra, Australia, and from the National Geographic Society and the National Bureau of Standards of the United States.

For obvious reasons, it is not possible to give full details of the plans and personnel of the various parties. Both have been subject to change not only since the members of the expeditions from Great Britain were forced to withdraw but also afterwards. Taking the expeditions in the order of their position on the eclipse track we should have started with an account of the programme of the Aberdeen party to Brazil under Prof. J. A. Carroll, the interferometric study of wave-lengths and widths of the lines of the chromospheric and coronal spectra. This has been abandoned and we turn next to the other expedition to Brazil, the American party led by Dr. Irvine C. Gardner, chief of the Optical Instruments Section of the Bureau of Standards. Their eclipse camp will be set up at Patos, on high plateau land 200 miles inland from the Brazilian coast, where totality will last for nearly five minutes. Other members of the party are Dr. E. O. Hulbert of the Naval Research Laboratory, Dr. Paul A. McNally, S. J., director of the Georgetown College Observatory, Dr. C. C. Kiess and Dr. T. R. Gilliland of the Bureau of Standards and Mr. R. H. Stewart of the National Geographic Society.

The programme includes a complete motion picture record in colour of the eclipse, special large photographs of the corona both in black-and-white and in colour, studies of sky brightness, sky radiation, sky spectra and of temperature and density changes in the atmosphere during the eclipse. Other points to be examined are the polarization of the coronal light, the flash and coronal spectra and the varying behaviour of the radio reflecting layers. The spectrographs designed for the eclipse are slitless, using aluminium concave gratings, one of 15,000 lines to the inch made by Prof. R. W. Wood of Johns Hopkins University and one of 30,000 lines to the inch made by Dr. H. G. Gale of the University of Chicago. One instrument will cover the range 3,000–5,500 A. and the other 5,000–10,000 A. The focal lengths are approximately 11 ft. and about 40 inches of spectrum will be secured.

A new feature of the work of this eclipse party lies in the tying together of the different instruments by a combined electric and vacuum control system, which will make the operation of the numerous units almost automatic. The scientific workers free from the task of operating controls during totality will be able to observe the eclipse visually. The method by which a roll of paper punched with the necessary holes and slots is run through a programme clock making electric contacts which open and close shutters, wind films and measure exposures to the fraction of a second has certain obvious advantages. Whether this replacing of the human element by the machine leads to ultimate general success or not under eclipse conditions remains to be proved.

The next party to observe the eclipse will be from the Cape Observatory under Dr. J. Jackson. The party cannot now be joined by an expedition from the Royal Observatory, Greenwich, under the Astronomer Royal. Another attack on the determination of the Einstein coefficient is being made to determine whether the high value found by one or two observers is supported. The party will be at Calvinia, and advantage may be taken of the wonderfully transparent sky there for Dr. Stoy to put through a limited photometric programme with the astrographic telescope before the eclipse. Dr. Allen from Canberra will join the party at Calvinia, working on the photometry of the flash spectrum and of the coronal spectrum. The relation between the polarization and wavelength in the continuous spectrum will be especially studied in order to help to determine the nature of the reflecting particles in the corona. It is unlikely that Dr. Woolley will be able to get away from Government work in Australia, so that the full programme originally planned, which included an examination of the absolute magnitude of the sun, is unlikely to be completed. Dr. Higgs from Canberra will proceed to Victoria West for radio investigations. Mr. Mackie from New Zealand had planned to accompany the party from Australia to study the photometry of the corona, but it is not certain that he will be able to make the journey.

Prof. H. Dingle's plan to observe the flash spectrum close to the cusp from a station on the edge of the belt of totality has had to be abandoned, and the only other expedition known here is the one from the Radcliffe Observatory, probably at Nelspoort. This was to have been a joint expedition with the Solar Physics Observatory, Cambridge (Prof. F. Stratton and Dr. A. D. Thackeray), and the apparatus used will mainly consist of instruments taken out to previous eclipses. The recent sad death of Mr. E. G. Williams has robbed this party of an experienced eclipse observer and British astronomy of one of its most promising younger workers. Dr. Redman will work with a camera with a moving film, taking intermittent stationary photographs of the flash spectrum through second and third contact. This will provide a valuable duplication in a different form of part of the programme at Calvinia. The Hills 4-prism quartz spectrograph may also be used in an attempt to secure new lines in the extreme ultra-violet in the coronal spectrum.

A very reduced programme is necessarily being attempted by a diminished number of parties from Great Britain, but there is very considerable importance in the researches that are being attempted and it is to be hoped that fine weather conditions will favour all the parties.

OBITUARIES

Sir Denison Ross, C.I.E.

We regret to record the death of Sir Denison Ross, Orientalist and first director of the School of Oriental Studies in the University of London, which took place in Istanbul on September 20 at the age of sixty-nine.

Edward Denison Ross, son of the Rev. Dr. A. J. Ross, was born in Stepney, London, on June 6, 1871, and was educated at Marlborough and at University College, London. Afterwards he studied Oriental languages in Paris and at Strassburg. He then travelled in the East in company with the late F. H. Skrine, visiting remote countries in central Asia, of which he had already made the acquaintance in literature, when in collaboration with Ney Elias he had translated the "Tariki-i-Rashid: a History of the Moghuls of Central Asia" by Mirza Haider Dughlat, a relative and contemporary of the Emperor Baber, the founder of the Moghul Empire in India. The events and observations of Ross's travels were recorded in "The Heart of Asia", written in collaboration with his fellow-traveller.

During 1896–1901, Ross occupied the chair of Persian art in University College, London. In the latter year he went East to become principal of the Madrasah, the well-known institution for the education of Moslems in Calcutta. To this appointment was added in 1906 that of curator of the records of the Government of India and assistant secretary of the Department of Education. In 1912 his services were recognized by the award of the C.I.E. Two years later he returned home and was appointed an assistant in the Department of Prints and Drawings of the British Museum and keeper of the Aurel Stein Collection of Antiquities and Prints there. In the two years during which he held this appointment he began the arrangement of the vast and invaluable collection of examples of Buddhist art which had been brought to the Museum from Central Asia by Sir Aurel Stein, with whom his friendship was one of long standing.

When in 1917 the School of Oriental Studies was opened in the University of London on lines recommended by a committee over which the first Lord Cromer had presided, it was almost inevitable that Ross should become the first director. His personality, his social gifts, and his enthusiasm for linguistic studies, no less than his successful achievement in Calcutta, where he had not only established the study of the Tibetan language but had also brought together a vast and unrivalled collection of Arabic and Persian manuscripts, singled him out as the man most suitable for an appointment imposing upon the holder the task of building up an institution, of which the significance as an imperial asset, outside its academic ambit, was not immediately apparent to more than a relatively restricted circle.

The choice of Denison Ross as director of the School was fully justified. Within a few years it had gained recognition as a great imperial institution. Thanks to a large teaching staff of widely ranging qualifications its instruction in the languages and cultures both of the East and of Africa not only fulfilled the primary academic function of a university institution, but also served the invaluable purpose of contributing to the administration of the Empire by equipping both officers and missionaries for the more efficient performance of the duties they had undertaken, or were about to undertake, among backward and other peoples of the British dependencies. Concurrently with his directorship, Ross held the appointment of professor of Persian in the University of London. He retired from both offices in 1937 and was made emeritus professor in 1938.

That so great a breadth of outlook in the work of the School of Oriental Studies was in fact attained in the early years of its existence was largely due to Ross's influence and inspiration. Not only had he an extraordinary enthusiasm for the study of languages, but he was also capable of inspiring a like interest in others. He himself spoke a number of European as well as Oriental languages; and it is a mark of his versatility that concurrently with his tenure of the chair of Persian he was also honorary lecturer in Portuguese at King's College, London. Nor was his interest that of the philologist only. His travels in Russia, Asia Minor, Central Asia, China and Persia had made his acquaintance with their tongues both intimate and colloquial. As was shown by much of his written work—he was an indefatigable and voluminous writer on an almost unlimited range of topics—a language was for him not so much an end of study in itself as an instrument for understanding the culture, the art, the institutions and the history of a people. This came out clearly in such of his written work as his study of the life and times of Omar Khayyám, or his introduction to Beckford's "Vathek", but can be most readily appreciated from his introduction to the catalogue of the exhibition of Persian art held at the Royal Academy in London, and in his contributions to the "Cambridge History of India". Apart from his studies and translations of works on Arabic, Persian and Indian history, literature, and art, one of his more noteworthy publications was a polyglot list of birds in Turki, Chinese, and Manchu.

Ross was a fellow of University College, London, and of the University of Calcutta. He was the recipient of academic honours from numerous universities, was knighted in 1918, and was awarded the Gold Medal of the Royal Asiatic Society in 1935. Early in the present year he was invited to become the head of the British Information Bureau at Istanbul, a position for which, as results showed, his personal gifts made him peculiarly well fitted in the present crisis in world affairs.

Dr. J. Burtt-Davy

JOSEPH BURTT-DAVY, who died on August 20, was born on March 7, 1870, at Findern, Derby. He was educated privately. During 1891–92 he worked as an assistant in the Director's Office at Kew. On leaving Kew he went to California, where he worked as a research student and held various botanical posts in the University, finishing there in 1902 as instructor in botany. It was there that he also met his wife. Afterwards he served as assistant curator in the United States Department of Agriculture, Washington, D.C. During his stay in America he published several short papers on the vegetation of California, the vegetation and crops of the Colorado delta, and he contributed the accounts of the glumaceous families of Monocotyledons for Jepson's "Flora of Western Middle California".

In 1903, Burtt-Davy was appointed agrostologist and botanist in the Department of Agriculture at Pretoria, a post he held until 1913. During that time he made large collections of Transvaal plants which formed the basis for the fine national herbarium now housed at the Union Buildings, Pretoria. On leaving the Government service he started farming on his own account at Vereeniging in the Transvaal. He made this a success and retired soon after the War of 1914–18 in order to commence work on his "Flora of the Transvaal and Swaziland", settling at Kew for some years for this purpose. This entailed an immense amount of work, in which he was helped by various members of the Kew staff, whilst at times he employed two private assistants.

After publishing the first two parts of his Transvaal Flora, and preparing most of Part 3, however, Burtt-Davy gave up the work to take up the post of lecturer in tropical forest botany at the Imperial Forestry Institute, Oxford. There he helped to train many young forestry officers for departments overseas, who in return made herbarium collections for the forestry herbarium at Oxford. In this way Burtt-Davy brought together a most valuable herbarium of ligneous plants, which it will be necessary to consult for any floristic works that may happen to be written in the future.

Besides his floristic work, Burtt-Davy wrote many papers on various branches of botany. His largest and most important economic work was his book entitled "Maize, its History, Cultivation, Handling and Uses". He was particularly interested in ecology and wrote on the "Climate and Life Zones of the Transvaal", and on the "Suffrutescent Habit as an Adaptation to Environment". Burtt-Davy will be greatly missed by his many friends in forestry and botanical circles, and particularly at the annual meetings of the British Association, which he attended regularly.

J. HUTCHINSON.

Miss E. L. Turner

MISS EMMA LOUISA TURNER, who died in Cambridge on August 13, was born in 1867. She was the pioneer of women bird photographers and was awarded the Gold Medal of the Royal Photographic Society. She was one of the first ten women fellows of the Linnean Society, and one of the first honorary lady members of the British Ornithologists' Union. She was also a president of the Norfolk and Norwich Naturalists' Society, vice-president of the Royal Society for the Protection of Birds and an honorary member of the Federation of University Women.

Though her early life was spent in Kent, Miss Turner will always be identified with Norfolk for her ornithological work there, both on the broads where, living in a houseboat at Hickling, she made an intensive study of marsh birds, and on Scolt Head where she spent much time alone as a voluntary watcher and made valuable records of bird migration.

Miss Turner had a gift for expression both in the spoken and written word and her lectures and books equally reflected her keen sense of humour. She was a valued supporter of the Cambridge Bird Club and her friendly readiness to assist with advice and encouragement gained for her the real affection of the undergraduates and the many friends with whom her bird work brought her in contact.

P. B-S.

NEWS AND VIEWS

Unity and Resolution

THESE were the keynotes of the address broadcast by the King on September 23. The nation is now united as never before, united in both work and suffering: "we are a nation on guard and in the line. Each task, each bit of duty done, however simple and domestic it may be, is part of our war work." The British peoples entered the War a little more than a year ago, with the knowledge that they were opposing a formidable foe, but confident in the justice of their cause. Since then, "Great nations have fallen. The battle, which was at that time so far away that we could only just hear its distant rumblings, is now at our very doors. The armies of invasion are massed across the Channel, only twenty miles from our shores. The air fleets of the enemy launch their attacks, day and night, against our cities. We stand in the front line, to champion those liberties and traditions that are our heritage."

In the great struggle now going on, we are supported by the efforts of the numerous contingents of our Allies, by the good will of all who love freedom, which, as in the United States, has shown itself in many ways, and particularly by the British Commonwealth of Nations itself, from every part of which men and material are flowing in, eager to share in the sacrifices needed for victory. "As in London, so throughout Great Britain, buildings rich in beauty and historic interest may be wantonly attacked, humbler houses, no less dear and familiar, may be destroyed. But 'there'll always be an England' to stand before the world as the symbol and citadel of freedom. . . . We live in grim times, and it may be that the future will be grimmer yet. Winter lies before us, cold and dark. But let us be of good cheer. After winter comes spring, and after our present trials will assuredly come victory and a release from these evil things."

The George Cross and Medal

IN the course of his broadcast address, the King announced the institution of two new honours, the George Cross and the George Medal, to reward the performance of deeds of valour by civilians, men and women, in all walks of life. Although it is intended that awards shall be made for gallantry arising out of enemy action, it will also be given for other brave deeds. The George Cross will rank with and immediately after the Victoria Cross, and will take the place of the medal of the Order of the British Empire for Gallantry; a small military Division will permit of its award to members of the Fighting Services who have performed acts coming within the terms of the warrant. The George Medal will be given more freely, but the standard will be high.

The Future of Polish Science

SINCE the restoration of Poland after the War of 1914–18 concentrated efforts have been made to develop and co-ordinate the scientific work of the country. During a difficult period of reconstruction, great progress was achieved and, in addition to the six universities, a number of other centres were available for learning and research. Before the outbreak of the present War, there were approximately 850 professors, 520 assistant professors and 1,600 research assistants and readers; the number of students being about 48,000. With the overrunning of Poland by Germany and the U.S.S.R., systematic and thorough methods have been employed to destroy its scientific life. This is being achieved in German-occupied Poland by the imprisonment of university staffs and scholars, the commandeering of specimens and equipment for use in the German Reich, the destruction of publications and libraries, and the closing of all centres of learning and higher education. Similar conditions exist in Soviet occupied territory. Professors and research students have no means of continuing their work and the future of Polish science has been further jeopardized by the closing of secondary schools, thus destroying the source of future students. Fortunately, however, some forty-six Polish scientific workers have been able to reach England. They comprise among their subjects, anatomy, zoology, bacteriology, chemistry, physics and branches of engineering and mechanics; the majority can speak at least three languages. It is the Polish Government's earnest endeavour to conserve, through these men, the future of science in Poland. A few will be able to obtain British Council scholarships and will be placed by the Council in British research institutions. The remainder will be given partial assistance from the very modest funds possessed for this purpose by the Polish Government.

The difficulties confronting the research workers who have no personal contacts in Great Britain are very great, not least among them the understandable antipathy and mistrust of foreigners which now exists in the country. The importance of securing the future of science and learning in Poland, however, will be fully realized, and by assisting to bring about the admission of Polish workers to research institutions in the British Commonwealth of Nations, British men of science can thus help to ensure a nucleus of Polish intellectuals. Also it must not be forgotten that Poland is an ally of Great Britain, who has at no time and in no way failed her, and that a common bond of hardship has drawn the two countries together in friendship.

Sir Frank Stockdale, K.C.M.G., C.B.E.

THE appointment is announced of Sir Frank Stockdale, who has been agricultural adviser to the Colonial Secretary since 1930, to be Comptroller for Development and Welfare in the West Indies. Sir Frank's departure from the Colonial Office will be felt by the many officers in the agricultural services of the Empire with whom he was on terms of personal intimacy and by all who had learnt to value his wide knowledge of the science and practice of tropical agriculture. He is returning to the scene of his early labours, for in 1905 he was mycologist to the West Indian Department of Agriculture. Afterwards he served as assistant director of science and agriculture in British Guiana, and as director of agriculture in Mauritius and in Ceylon. He held the latter post until 1929, when the then Colonial Secretary, Mr. Ormsby Gore, selected him as agricultural adviser to strengthen the liaison between the rapidly developing scientific branches of colonial agriculture and the administration in Whitehall. He fulfilled this function brilliantly, and the very active interest now shown by the Colonial Office in promoting scientific agriculture in the territories under its jurisdiction is largely a consequence of his work. He was knighted in 1937.

Much of Sir Frank's time was spent in studying agriculture in the Colonies themselves, very few of which he has not visited. His reports on these visits are admirable, if summary, examples of the conditions and problems confronting colonial agriculturists. Of recent years his special interests have been agricultural co-operation and soil conservation—two matters which happen to be of vital importance to the restoration of prosperity in the West Indies. The post of Comptroller for Development and Welfare has been instituted on the recommendation of the West India Royal Commission 1938–39, which recommended the establishment of a West Indian Welfare Fund financed by an annual grant of £1,000,000 to be administered by a comptroller with wide powers of discretion. The post is the keystone of the programme of social reform and rehabilitation recommended by the Commission. Sir Frank Stockdale is succeeded at the Colonial Office by Dr. H. A. Tempany, who has had long experience of colonial agriculture in the West Indies, Mauritius and Malaya. He has held the post of assistant agricultural adviser to the Colonial Secretary since 1936.

Supplies of Vitamin C

STATEMENTS have recently appeared in the German scientific press to the effect that German men of science have discovered that the hips of the wild rose are a rich source of the antiscorbutic vitamin C, and that the German State railways have arranged to grow wild roses along the tracks. It is said that half a million plants are to be acquired for this purpose alone, and that other waste lands are to be used in the same way. Actually the discovery that hips are so active is not a new one. It was one of the various materials found to be unexpectedly potent as the result of the introduction of a chemical method of testing for vitamin C. This method was worked out largely in Great Britain. Another fruit found to be unexpectedly active was the blackcurrant. The latter is at least eight times as potent as orange juice or lemon juice, and dried hips about thirty times.

For some years past, hips have been used as a raw material for vitamin C, not only in Germany, but also in parts of Scandinavia and in the U.S.S.R. In the latter country pine needles have likewise been worked up on an enormous scale to provide vitamin C in the northern regions where scurvy has been rife in the winter months. A dried preparation of rose hips has been available commercially for some time in Great Britain. It has the disadvantage of a somewhat fibrous consistency; and while synthetic vitamin C is so cheap, it seems doubtful if the labour of collecting and extracting the vitamin from wild hips would be worth while here in England. With our plentiful supplies of potatoes, we need fear no shortage of vitamin C, even in a long war.

Archæology During and After the War

MR. A. W. CLAPHAM in his presidential address to the Society of Antiquaries of London, of which the text is now available in full (*Antiq. J.*, **20**, 3, July 1940), raised two points of current interest. He deplored that several archæological excavations had suffered untimely interruption on the cessation of field work on the outbreak of war, and also expressed the alarm which he felt in common with all interested in archæological studies at the way in which military exigencies are endangering or causing the disappearance of earthworks, barrows and other monuments of antiquity. While the Society is exercising such vigilance as is possible in the circumstances, Mr. Clapham feared that little could be done except complete a record, before the threatened relics vanished for ever. The action of the Society in urging upon the Colonial Office that steps be taken for the protection of the antiquities of the Hadramaut, of which Miss G. Caton-Thompson had given an account, has as yet produced no result. Dr. R. E. Mortimer Wheeler, however, has been fortunate enough to be able to complete the work in Brittany begun in 1938, although further investigations had to be abandoned when work ceased abruptly in August 1939.

Turning to the question of archæological investigations in a post-War future, Mr. Clapham, however regretfully it is admitted, was fully justified in predicting a much restricted activity in which the large-scale excavations of past years will not be possible. The heavy expenditure involved will place such undertakings beyond the bounds of possibility. He was the less inclined to deplore this outcome of the War on the ground that in the field of British archæology the major problems of the prehistoric periods had been resolved and future work might well be confined to filling in details and closing gaps in archæological knowledge. Of one period, however, he made an exception and pointed to the Dark Ages as a field still almost wholly unexplored. In the work of conservation, also, which he regarded as an important sphere of activity for the post-War archæologist, he stressed the importance of the much-neglected study of carved stones and architectural features and their care as well as their display. In going on to discuss the possibility of the formation of a national museum of British sculpture he raised, as he showed himself to be aware, a question which is as difficult as it is urgent.

A.R.P. Wardens' Warning System

The life of an A.R.P. warden is in general a strenuous one. Night after night he may be called from his bed for alarms real and false. Many nights also are spent at a post on stand-by duty, which, but for the present call-up system, could have been passed in the comfort of his home. In the *Electrician* of September 6, it is recalled that some years before the War many local authorities installed special control systems for street lighting which at the time, it was anticipated, would be permitted to be used in the event of the outbreak of hostilities. These systems were described in the *Electrician* and each one incorporated a signalling arrangement for calling fire and ambulance services, police, wardens and other A.R.P. workers. Unfortunately, the complete black-out of our streets ordered last September rendered the control system of little immediate use, though we learn that the wardens' call unit which forms a component of the system is being used in at least one provincial town. This unit consists of a plug-in device for insertion in a lamp-holder and is carried by the warden as part of his equipment. Whether he is at home, or at the house of a friend, plugging the unit in the supply network puts him within calling range of the A.R.P. authorities, whenever wanted, by its response to a D.C. impulse transmitted over the mains from the local control point.

Any device which will permit A.R.P. workers to spend more time at home will tend to improve the efficiency of the civil defence service as a whole, for with proper rest and normal social intercourse, those who man the service will be better able to meet the demands upon their time and energies. There must be many local authorities with similar systems installed but not yet in use, and it is suggested that regional commissioners sanction their employment at once. Those authorities who are as yet without such call-up systems should in their turn be prevailed upon to bring their local defence arrangements in line. For their information it may be mentioned that the systems cost relatively little to instal, and the call-up units less. The increase in efficiency of the A.R.P. service turn-out in the case of a preliminary or general alarm is out of all proportion to the expenditure involved.

Physical Society Colour Group

At a meeting held on May 16, under the authority of the Council of the Physical Society and attended by a number of those interested in colour problems, it was unanimously agreed to form a Group with the title of "The Physical Society Colour Group". The objects of this Group will be to provide an opportunity for the various groups of people concerned with colour—physicists, chemists, industrialists, etc.—to meet and become familiar with each other's problems, to enable a representative opinion to be formed on various questions of standardization, specification, nomenclature, etc., and generally to encourage colorimetric investigations and to ensure that this country shall keep abreast of developments abroad. At the above meeting the following officers of the Group were elected: *Chairman*, Dr. W. D. Wright; *Hon. Secretary*, Mr. H. D. Murray; *Committee*, Mr. H. W. Ellis, Mr. J. Guild, Mr. J. G. Holmes.

It will be appreciated that the objects envisaged in the formation of this Colour Group can best be achieved by co-operation of all those interested in colour problems, in whatever field these problems may arise. For this reason, it is felt by those responsible for the formation of the Group that it should be regarded as a meeting ground for all in science and industry who have a common interest in colour, rather than as a self-contained and independent society. Accordingly, a number of societies have been invited to become founder societies of the Group and to co-operate in its activities. It is hoped to hold the first general meeting of the Group, to be followed by the first scientific meeting, in the middle of October. The general subject for discussion will be "Colour Tolerance". Further information can be obtained from Mr. H. D. Murray, Physical Society, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

Highway from Alaska to the Argentine

A wide high-speed double-track road from Alaska to the Argentine is proposed by the American Automobile Association as an important factor in plans for the defence of the Americas. In a letter to Senator Morris Sheppard, chairman of the Senate Military Affairs Committee, and Mr. Andrew J. May, chairman of the House Military Affairs Committee, Mr. Thomas P. Henry, president of the Association, stated that along many stretches of the proposed route, the road is already built. He urged that the linking up of these separate sections should be undertaken with the least possible delay.

"For many years," he wrote, "American motorists have been looking forward to the eventual completion of an All-America Highway from Alaska to the Argentine, connecting the lands of the Western Hemisphere. Hitherto it has been regarded mainly as a tourist asset, a means of opening up new travel objectives and as a promoter of friendship between the various peoples. But the present world crisis puts an entirely new light on the project. The United States, embarked already on a programme of building up its national defences, and pledged to protect the entire hemisphere against aggression, has a greater need of the highway than ever before".

Depopulation in France

In a recent thesis (*Thèse de Paris* 1940, No. 311) Dr. H. Birnbaum remarks that for more than a century the population of France has shown only a very slight increase; from 34 millions in 1840 it has risen to only 42 millions in 1940. At the same time there has been a very pronounced fall in the annual number of births, namely, from about a million in 1840 to a little more than half that number in 1939. During the same period owing to the progress of medicine and hygiene as well as of certain technical acquisitions the average duration of human life has increased by about twenty years, so that the average span of life in 1940 is about 60 years as compared with 40 in 1840. According to Dr. Birnbaum, depopulation in France is due to individual and voluntary limitation of births, whether this limitation is due to anticonceptional measures or to criminal abortions, of which latter more than 300,000 are carried out on married women in France every year.

Retail-Store Training

A Bulletin by K. B. Haas (Vocational Division Bulletin No. 205, Business Education Series No. 12) which has been issued by the Office of Education, United States Department of the Interior, under the title "Co-operative Part-Time Retail Training Programmes", reviews the history and progress of retail-store training programmes. It discusses the need for training programmes in secondary schools and extension classes and describes the kinds of training programmes which have prospects of success. Proved methods for promoting, initiating, co-ordinating, supervising and teaching the various types of retail-training courses in different communities are indicated as well as both the factors contributing to the success of such programmes and mistakes which have been made. The qualifications necessary for teachers of such subjects are discussed, and emphasis is placed on the co-operative part-time type of instruction on the secondary level.

The Colonial Service: Recent Appointments

The following appointments and promotions in the Colonial Service have recently been made: P. G. Coleman, agricultural officer, Malaya; M. D. ffrench-Mullen, agricultural officer, Fiji; F. B. Leech, veterinary officer, Nyasaland; G. C. L. Bertram, chief fisheries officer, Palestine; C. L. Gulliver, meteorological assistant, Nigeria; A. S. Richardson (deputy director of Agriculture, Uganda), director of agriculture, Nyasaland; D. H. Hodgson (conservator of forests), deputy director of forests and deputy adviser on forestry, Malaya; H. E. C. Lushington (assistant conservator of forests), senior assistant conservator of forests, Ceylon; J. G. Watson (deputy director of forests and deputy advisor on forestry), director of forests and adviser on forestry, Malaya.

The Night Sky in October

The moon is new on October 1 and 30 and full on October 16. Jupiter and Saturn are in conjunction with the moon on October 18d. 0h. and Venus on 28d. 4h. U.T. The 4th magnitude star, α Cancri, is occulted on October 25, the disappearance occurring at 1h. 48·3m. (at position angle 116° from the north point) and the reappearance at 2h. 49·8m. at position angle 267°. Jupiter and Saturn, still close together, rise before 18h. in mid-October. These two planets are in conjunction with one another on October 11 at 23h., but their closest approach (1·2°) occurs on October 19. Close groupings of Jupiter's four inner satellites can be seen at 0h. 15m. on October 3, 4, 11, 12 and 19 (all to the eastward side), 21, 28 and 29. Examples of wide separation occur on October 6, 8, 15 and 31. Venus, the brilliant planet rising about four hours before the sun, is close to Regulus on October 6 and near β Virginis on October 29. Conjunction with Neptune is on October 29 at 21h. The Orionid meteors reach their maximum frequency about October 19, the radiant point being north, following α Orionis (Betelgeuse).

The new moon on October 1 is associated with a total eclipse of the sun, the path of totality, some 120 miles wide, crossing Brazil, the South Atlantic to South Africa. The duration on the Brazilian coast will be 5 minutes; north-east of East London, South Africa, the duration is 3 min. 24 sec. A general article referring to arrangements for observing the eclipse appears on p. 422 of this issue.

Announcements

Among the changes in the Schedule of Reserved Occupations recently announced is the statement that scientific and research workers may now volunteer for general service in the armed forces irrespective of age, provided that consent is obtained from the Committee for Scientific Research of the Central Register Advisory Council.

During the continuance of the present disturbed conditions, the library of the Chemical Society at Burlington House, London, will be closed on Saturdays. So far as circumstances permit, it will be open on other weekdays from 10 a.m. until 5 p.m.

The Rockefeller Foundation has given £1,000 to the Royal Society of Medicine for the preservation of its library. It is proposed to evacuate to a suitable house a number of the older and irreplaceable periodicals. A member of the library staff will accompany them and will be in telephonic communication with the library in London.

The fourth Pan-American Congress of the Red Cross will be held at Santiago, Chile, during December 5–14 under the direction of General L. Brieba, president of the Central Committee of the Red Cross in Chile.

Many valuable zoological collections recently gathered in Central America for the British Museum are being housed in the Field Museum of Natural History, Chicago. After an expedition headed by Ivan T. Sanderson, of Belize, British Honduras, had completed its work of collecting mammals, reptiles and various invertebrate animals in Central America, the War made it unsafe to ship them to England. The Field Museum, therefore, offered its hospitality, and the first large instalment of Mr. Sanderson's material has recently arrived there. Some of it is to be classified there, at his request, and ultimately some division of the collections will be made between the Field Museum and the British Museum.

The International Commission on Zoological Nomenclature has commenced the publication of the Opinions rendered by the Commission, vol. 2, Opinions 134–136. Copies may be obtained from the Commission, c/o Royal Entomological Society of London, 41 Queen's Gate, South Kensington, London, S.W.7.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Camouflage in Modern Warfare

RECENT articles and correspondence in NATURE[1] have painted a gloomy and even alarming picture of the inefficiency of the departments in Great Britain responsible for camouflage. We are led to suppose that the work is mainly entrusted to artists who cannot be expected to understand what they are doing, instead of being under the control of properly qualified scientific men who are familiar with the "fundamental biological principles" involved. We are left with the impression that the work is being carried out with a degree of incompetence which can only lead to disaster, and although it is not specifically stated, there is a strong suggestion that since modern camouflage was brought into being a quarter of a century ago by an eminent zoologist, and since biologists have made an intensive study of the methods by which animals conceal themselves, it follows that camouflage is a special province of the biologist to whom alone the ultimate control can safely be entrusted.

Whilst I am sure that the authorities are fully aware of the debt that they owe to biologists in the past and would welcome their further help and co-operation, I do not believe that the most urgent problems which are still awaiting solution are of a biological character at all, but are rather questions for the engineer, the chemist and the physicist. The "fundamental biological principles" seem to me to be neither profound nor difficult to understand; in fact they are so fundamental that the average artist or physicist can grasp them without any great intellectual effort. It remains to discover how to apply these "principles" to the practical problems of camouflage and to put accumulated experience to the best possible use—and this is where the artist comes in. Whether he stands back from his easel to view his work or whether he goes up in his aeroplane, the successful application of the "fundamental principles" is ultimately a matter of experience and of trial and error, for the simple reason that one objective is as different from the last as one man's face is different from another's.

I am in close contact with the work of the Civil Defence Camouflage Establishment and it may perhaps be a surprise to readers of the articles in NATURE to learn that this Establishment is under the control of a distinguished physicist and that biology, engineering, physics, and chemistry are all represented on the Camouflage Committee; it is my own belief that progress can only be made by the co-operation of workers in every field and that it would be absurd to stake a claim for the paramount importance of any particular branch of science. Camouflage to-day is practised by all and sundry, and it is not surprising that we find many examples which look absurd; and often are absurd. It does not seem to matter much what the omnibus companies do to the tops of their buses; it gives us something to laugh at or to grumble about. Of course, what really matters is what important camouflaged objectives look like *from the air*; and this is quite a different story.

There has been no civil aviation in Great Britain since the outbreak of War and members of the Fighting Services and Civil Servants are precluded from any public expression of opinion. If I were an expert in these matters (and I make no such claim) I would not venture to praise or to censure the work of the camouflage departments for one simple reason---that as I have not seen it from the air my opinion would be of little value.

T. R. MERTON.

Winforton House,
Hereford.
August 17.

---

[1] NATURE, **145**, 949 (1940); **146**, 112 (1940); **146**, 168 (1940).

SINCE the appearance on June 22 of a leading article entitled "Camouflage in Modern Warfare" in NATURE, the War has entered upon a new phase, in which the enemy has repeatedly sent large formations of bombers in search of targets over Great Britain. Now more than ever before in our history has camouflage become a matter of national importance. Prof. Merton complains that the above article presented "a gloomy and even alarming picture of the inefficiency of the departments in Great Britain responsible for camouflage". Complacency and mutual congratulation will not help to remedy matters in these stirring times.

Biologists do not claim that camouflage is their exclusive province, and they are well aware that a satisfactory solution to problems of visual concealment and deception on a gigantic scale can only be achieved by their co-operation with experts in other fields—architects, structural engineers, chemists, physicists, psychologists. But the fact remains that the most effective camouflage yet devised is that displayed in the coloration of various wild animals; that in this field man has lagged far behind the inventiveness of Nature; and that while the biologist knows how these results have been achieved in Nature and how they could be applied to war purposes, the non-scientific camoufleur frequently does not and to that extent he is groping in the dark.

Prof. Merton remarks that the "fundamental biological principles" upon which visual concealment depends seem to him not difficult to understand. Nor are they: and no doubt there are authorities at the War Office who could understand them. Yet there is little indication at present that those responsible for the camouflage of heavy-calibre guns, and of tanks, transports, and other army vehicles are even making an attempt to do so. Moreover, it appears that they refrain from accepting advice on these matters.

For example, the principle of countershading is applicable to solid structures of all kinds; and indeed all camouflage by paint should be worked out on this basis. Countershading is particularly appropriate to cylindrical bodies such as guns, just as it is in Nature to the bodies of snakes and caterpillars. So recently as August 29, 1940, a well-known daily paper published a photograph of two 12-in. coastal defence guns, each bearing the conventional camouflage pattern which is a peculiarly senseless and ineffective thing, and which entirely fails either to break up surface continuity, to obliterate outline, or to nullify the appearance of solidity due to light and shade. In other words, the official scheme ignores or defies three of the fundamental optical principles which according to Prof. Merton are so fundamental that any artist can grasp them without any great intellectual effort.

Week by week since the outbreak of war we have seen in the Press similar illustrations of incompetence and ignorance. Again, in the painting of Army and R.A.F. transports, we look in vain for any evidence that these principles of countershading and of disruptive and coincident coloration have really been grasped, or for any signs of radical improvement in the systems of patterning adopted.

The futility of attempting to camouflage an object by daubing its surface with patches of grey, brown or green paint of nearly equal brightness has been repeatedly stressed in these pages and elsewhere. Yet so consistently has this method been adopted by the authorities that for many people the term 'camouflage' has come to mean parti-colouring with drab colours. The danger of this misconception of camouflage lies in the belief that any object so coloured will be camouflaged!

The importance of knowing what camouflaged objectives look like from the air is rightly stressed by Prof. Merton. So long as camouflage is directed against aerial reconnaissance and aerial bombardment, the view from above is the significant view. Prof. Merton states that he has not seen the work of the camouflage departments from the air. On the other hand, it is in the light of flying experience and as a result of observation both from the air and from the ground that these criticisms are made by

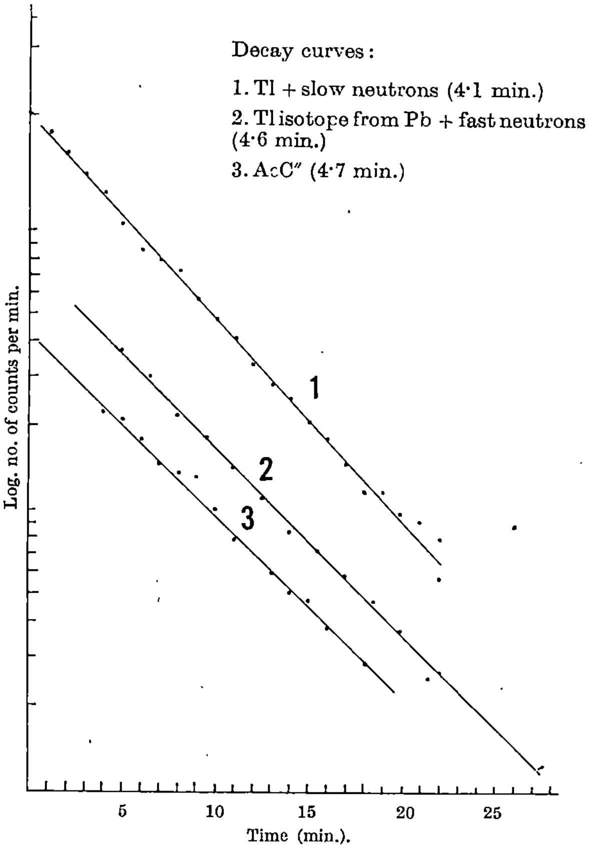
THE WRITER OF THE ARTICLE.

Production of Actinium C″ from Lead

THE production of members of the natural radioactive series from stable nuclei is a result of considerable interest. Hitherto, radium E and polonium[1] have been obtained by bombarding bismuth with deuterons, and uranium Y has been reported[2] as arising from the interaction of fast neutrons with thorium. We have been able to obtain actinium C″ from lead by bombardment with neutrons. From the accompanying table of isotopes, it will be seen that the reaction Pb^{207} (n,H)Tl^{207} would lead to this result, whilst similar processes with Pb^{208} and Pb^{206} would give rise to ThC″ and Tl^{206} respectively.

	Z \ M	203	204	205	206	207	208	209
Tl	81	30 p.c.	4·1 min.	70 p.c.	—	4·7 min. AcC″	3·2 min. ThC″	—
Pb	82	—	1·5 p.c.	—	28·3 p.c.	20·1 p.c.	50·1 p.c.	—
Bi	83	—	—	—	—	—	—	100

On the other hand, the large nuclear charge of lead makes the reaction rather improbable, as the high potential barrier will tend to prevent the escape of the proton. In order to increase the sensitivity of the method, we therefore irradiated 500 gm. samples of lead nitrate for periods of 10 minutes and then separated chemically a few milligrams of thallium added as carrier for the actinium C″. It is of course desirable to use large amounts of lead only if the thallium formed is separated sufficiently rapidly, before the short-lived actinium C″ has time to decay. When lead nitrate was employed, the necessary operations consisted in dissolving the nitrate in hot water, removing the lead as sulphate, isolating the thallium as the sulphide Tl_2S from the filtrate, drying the precipitate, and mounting it on our standard holders for counting. After some practice we succeeded in carrying through all these operations regularly in about 5 minutes, which meant a loss of little more than half the actinium C″ actually formed during bombardment. The decay of the active body isolated in this way was followed over six half-lives, and a final value of 4·6 min. was obtained for the half-value period.



Numerous decay curves were then taken with actinium C″ obtained by recoil from the active deposit, and also of the 4-min. activity which is obtained when thallium is exposed to slow neutron bombardment. The mean value for the period of the recoil preparations was 4·7 min. and that of the thallium isotope obtained by slow neutron irradiation was 4·1 min.

Taking these results together, it may be concluded with considerable assurance that the product of fast neutron bombardment of lead is in fact actinium C$''$, and that very probably neither in this bombardment nor in the slow neutron bombardment of thallium is any evidence for the production of Tl^{206} forthcoming. This last conclusion is in agreement with the previous assignment[3] of the 4·1 min. activity to Tl^{204}. If the difference between the half-life of actinium C$''$ (4·7 min.) and that of thallium (4·6 min.) is real, it is consistent with the simultaneous formation of thorium C$''$ and actinium C$''$.

The neutrons used for preliminary irradiation were obtained from lithium bombarded with 100 μ amp. of 0·9 Mv. deuterons in the Cavendish High Voltage Laboratory, with the exception that for the final bombardment of the large quantities of lead nitrate, the cyclotron supplied the neutrons (Li + H^2 of 9 Mv., 5–10 μ amp., 10 min. exposure).

It was originally planned to supplement the experiments described above with absorption measurements, but the present emergency prevented us from doing so.

We are much obliged to Mr. D. C. Hurst and Mr. R. Latham for operating the cyclotron for us.

E. BRETSCHER.
L. G. COOK.

Cavendish High Tension Laboratory,
Cambridge.
August 28.

---

[1] Livinggood, *Phys. Rev.*, **50**, 425 (1936); Hurst, D. G., Latham, R., and Lewis, W. B., *Proc. Roy. Soc.*, A, **174**, 126 (1940).

[2] Nishina, Y., Yasaki, T., Kimura, K., and Ikawa, M., NATURE, **142**, 874 (1938).

[3] Heyn, F. A., NATURE, **139**, 842 (1937); Fajans, K., and Voigt, A. F., *Phys. Rev.*, **58**, 177 (1940).

Dependence of Thermal Diffusion on the Concentration Ratio

IN the design of experiments to separate isotopes by means of thermal diffusion, as for example by the highly successful continuously convective method devised by Clusius and Dickel[1], much depends on the value of α, defined by $\alpha = k_T/c_1c_2$, where c_1 and c_2 are the volume-fractions of the constituents 1 and 2 (so that $c_1 + c_2 = 1$), and k_T is the thermal diffusion ratio; α, which may be called the thermal diffusion *factor*, determines the magnitude, and its sign determines the direction, of the thermal diffusion.

Though the main features of the dependence of α on the molecular mass-ratio and (where the masses are equal) the diameter ratio have long been known, no systematic examination of the characteristics of α has hitherto been made. I have recently made such an examination of $[\alpha]_1$, the first approximation to α according to the Chapman-Enskog theory; this first approximation is correct within a few per cent, so that the results of the examination (which will shortly be published) are likely to be valid, to a high degree of approximation, for α itself. Some unexpected possibilities have thus been discovered.

One factor in α depends solely on the law of interaction between the unlike molecules. This factor, and therefore α itself, vanishes when the interaction is according to the inverse fifth-power law; for inverse-power laws of index higher than 5 (including rigid elastic spheres) the factor is positive, and for a lower index it is negative. The sign of the remaining factor in α has hitherto been tacitly supposed independent of the concentration-ratio c_1/c_2, and all the experiments so far made on thermal diffusion have supported this view. It now appears, however, that this is not necessarily true, and that α may change sign (once) as the proportion of either constituent increases from 0 to 1.

Moreover, it appears that in certain cases $[\alpha]_1$ may vanish for all concentration-ratios, although the mutual interaction is not according to the fifth power law, and the molecular masses and diameters are not equal.

If the method of Clusius and Dickel were applied to mixtures of gases for which α changes in sign as the concentration-ratio varies, the concentration-ratio c_1/c_2 would not tend to 0 at one end of the tube and ∞ at the other (corresponding to the pure gases), but at one end of the tube the ratio would tend to the value for which α changes sign. Though this will not occur for isotopic gas-mixtures, the phenomenon is of much theoretical interest, and worthy of experimental investigation.

S. CHAPMAN.

Imperial College of Science and Technology,
London, S.W.7.
September 6.

---

[1] Clusius, K., and Dickel, G., *Z. phys. Chem.*, **44**, 397 (1939).

Submarine Geology and Geophysics

THE brief article by Dr. Bullard entitled "Geophysical Study of Submarine Geology" which appeared in NATURE of May 18, p. 764, was gratifying in that it directed attention to some of the developments in the newest field of geological research. On the other hand, this article showed a pardonable lack of familiarity with many developments, particularly with work along the California coast carried on with the facilities of the Scripps Institution. Since the tentative conclusions suggested by Dr. Bullard are in no way confirmed by these investigations, a brief summary of the work and its implications might prove of interest to the readers of NATURE. To date only brief summaries of this work have been published, but forthcoming publications by the Geological Society of America can be consulted for amplification.

Dr. Bullard referred to the excellent charts which have been prepared by the U.S. Coast and Geodetic Survey showing the submarine canyons which cut the submarine slopes off the American coasts. These charts have been used as a basis for oceanographic investigation of the submarine canyons on the auxiliary ketch *Atlantis* off the east coast and on the auxiliary schooner *E. W. Scripps* off the California coast. Since 1933, I have devoted a large amount of time to making minutely accurate charts of the canyon heads off California and in collecting samples of sediment and rock from the canyons and vicinity. Also accurate range lines have been established and checked many times to look for changing depths within the canyons. During 1938 approximately six months of cruises on the *E. W. Scripps* were devoted to this work.

The *E. W. Scripps* is equipped with a gravity coring device designed by K. O. Emery and R. S. Dietz, which obtains cores up to 10 ft. in length, equalling those obtained by the Piggot gun, which, contrary to the impression given by Dr. Bullard, has not obtained 10-ft. cores in rock but in oceanic ooze. Hundreds of cores have been obtained with this gravity device. Hundreds of dredgings of rock also have been taken with large geological dredges. Currents have been measured in a score of different places on the ocean bottom both in and out of submarine canyons. The echo-sounding device on the *E. W. Scripps* has also been employed particularly to find out about the nature of the outer termination of the canyons off southern California. Parallel investigations of the east coast canyons have been undertaken by H. C. Stetson on the *Atlantis*.

Dr. Bullard states that the hypothesis that the submarine canyons are due to river cutting must be abandoned because the canyons extend to too great depths. However, it should be remembered that sea shells are found at high elevations in most mountain ranges. Before abandoning the river erosion hypothesis, would it not be better to look at some of the evidence from the canyon investigations? This evidence will, I think, prove disconcerting to those who wish to rule out the subaerial cutting. Thus we have found well-rounded gravel in cores and dredgings along the axis of many of the canyons and extending out to depths of so much as 5,000 ft. In places this gravel is mixed with shells which are certainly not of a deep-water variety. We have also found the water-worn gravel and even rounded cobbles on the banks off the California coast out to depths of 3,000 ft. At the head of the great Monterey submarine valley the deep fill shown by well cores gives unmistakable evidence of submergence great enough to account for at least a thousand feet of the submergence implied by the canyons.

The detailed surveys of the California submarine canyons reveal their close resemblance to the river canyons of the adjacent lands. These canyons are cut for the most part in rock. They have V-shaped cross-sections, winding courses, a river-like pattern of tributaries, and as continuous an outward slope as is typical of river canyons. While submarine processes are undoubtedly important in preventing the canyons from becoming filled, as is shown, for example, by the finding of submarine landslides, no process either of landslides or of submarine currents has as yet been detected which would appear to account for the canyon characteristics as well as that of subaerial origin. Our investigations show that the currents are not concentrated in the canyons nor do they attain proportions which could be expected to produce these great sea-floor gashes in the relatively short periods available for their excavation through the late Tertiary rocks found on their walls. These investigations cannot be said to have completely solved the mystery of the canyons, but they should at least show that one should not lightly dismiss the idea of subaerial excavation as has Dr. Bullard and as have various American writers in recent articles.

Dr. Bullard refers to the continental shelf as a mass of sediments built out on a gently sloping surface of rock. Possibly this interpretation may apply to some continental shelves, but again the evidence is largely in the opposite direction. Most of the dredging operations both on the outer portion of the continental shelf and on the walls of submarine canyons which cut into the shelf margin have revealed the presence of rock. This is not only true off the California coast, where the evidence is incontrovertible, but also is the case off the New England coast where Stetson found well-consolidated Cretaceous rock at a depth of a few hundred fathoms near the shelf edge. When Dr. Bullard refers to the 8,000 ft. of sediments overlying the rock on the continental shelves off both sides of the Atlantic, he should qualify the statement by noting that it is not easy to distinguish between soft sedimentary rock and recent sediments in geophysical determinations. Also Ewing's work off eastern United States is only thought by that writer to imply a thick section of sediments and sedimentary rocks overlying the granite basement.

The statement that the edge of the shelf does not represent a fault scarp but is simply the outer edge of the sediment pile is also one that is subject to debate. The continental slopes show a close topographical resemblance to the fault scarps of the lands. Judging from deltas, they are distinctly too steep for normal sedimentary accumulations. The finding of rock in many places on the slopes is also significant in this connexion. Their straightness further implies fault origin. The deep water at the base of these slopes, despite the evidence that sediments are accumulating much faster at the slope base than on the slopes, indicates that diastrophism must be keeping the base depressed. Finally, the common presence of troughs in the ocean floor adjacent to the continental slopes and the seismicity of these zones lend support to the idea that the continental slopes are tectonic. Here again, however, it is best to reserve judgment until more evidence is available. Submarine geology is still too much in its infancy to make positive statements advisable.

FRANCIS P. SHEPARD.

Scripps Institution and
University of Illinois.
August 13.

IN Prof. Shepard's interesting communication he differs from me on two main points. First, he thinks that the "canyons" were probably formed by subaerial erosion, whereas I do not know how they were formed; but I feel fairly certain that at any rate on the east coast of the United States the land has not recently stood thousands of feet higher than at present. To me it is inconceivable that the flat-lying sediments of the coastal plain can have been raised and lowered without leaving a trace in their structure and without affecting the physiography except near the outer edge. In California, broadly speaking, anything may happen. Large changes have occurred recently and are presumably still in progress, and there is nothing inherently impossible in assuming large relative movements of sea and land. It is the extension of the movements to practically the whole length of the shores of all the oceans that raises such great difficulties.

The second difference is that I suggested that the form of the continental shelf might be due to sedimentation whilst Prof. Shepard regards it as probably tectonic. This is not a matter on which I would wish to be dogmatic and it is a question which can be settled by mapping some discontinuity past the edge. The most promising horizon for this purpose seems to me to be the Palæozoic or Pre-Cambrian floor underlying the sediments under the continental shelf of the eastern United States and western Europe.

I agree that most of the shelf consists of well-consolidated sediments. Last year it was found that the velocities of seismic waves on the shelf south of Ireland were as great as 10,000 ft./sec. at a depth of a few thousand feet.

E. C. BULLARD.

Department of Geodesy and Geophysics,
Cambridge.

RESEARCH ITEMS

Trephining in New Britain

AN account of trephining methods employed by the natives of New Britain during tribal wars is contributed by J. L. Meacher, of Frankston, Victoria, Australia, to the *Brit. Med. J.* (No. 4156 ; Aug. 31, 1940). The observations were made and communicated to him by Mrs. Parkinson, who settled there sixty years ago. Skulls showing healed trephine wounds have been deposited by her in the Australian Museum of Anatomy. The operator first washes the wound with coconut milk and cuts the skin in the middle of the wound with a bamboo knife, dividing the skin into two halves. The wound is then scraped round with a black stone which "falls down from lightning", that is, a meteorite. The operator then blows into the wound through a bamboo pipe fourteen inches long to discover if there are any small pieces of bone there. A strip of coconut shell four or five inches long is used to extract pieces of bone. Coconut milk is used to wash the wound while bone is being extracted. The scalp flaps are then replaced and sewn up with a needle made from the wing-bone of a flying-fox and banana fibre thread. The wound is covered with a banana leaf, and over that the skin of the banana flower. To prevent air from getting into the wound, a paste of chewed pepper, lime and soft betel-nut is placed over the leaves. The whole head is covered with *taro* leaf and big round leaves of a bush called *paba*. A frame worked like a net protects the head. The patient is kept on a soft diet to obviate moving the jaws, while he must lie quiet for three days after which the doctor removes the frame to examine the wound. In case of malaise the wound is opened up, blown upon and scraped to remove fragments of bone previously overlooked. When a week has passed without pain the cure is tested by the eating of an old hard piece of coconut. Absence of pain indicates that no more pieces of bone are left, and the relatives are bidden to prepare a feast as the operator is about to remove the frame. Injury to the brain is treated by scraping the injured part and the insertion of a pad of *mal* (pounded wood of a small tree) which is left permanently in the wound. A pad of *mal* is also wrapped over the wound until it heals. [A description of trephining in New Britain was communicated to the Anthropological Institute in 1901 by W. Crum and Sir Victor Horsley, see *J. Anthrop. Inst.*, 32 ; 1902.]

Celtic Ornament from Elmswell, Yorks

A PANEL of Celtic ornament, described and analysed by Philip Corder and C. F. C. Hawkes (*Antiq. J.*, 20 ; July 1940), was found in the excavations at Elmswell, East Riding, Yorks, in 1938 on a native site of the Parisii occupied from Flavian times to the end of the Roman period, and then in subsequent pagan Saxon times. The site as a whole shows the persistence through Roman times of an Iron Age mode of life. The panel found, unstratified and unassociated, is a thin sheet of bronze covered with an embossed design of flowing curves garnished with rosettes. On the upper edge is fitted a strip of bronze ornamented with champlevé enamel of a bright orange-red (now green). Beneath is an iron plate bent at right-angles to form a flange. It appears to be a panel which ornamented the side of a box. It measures 9·5 inches by 3·1 inches. Such ornamented boxes it is known were made and prized in Britain in the period. Discussing the panel, Mr. Hawkes compares it with a bronze strip from the Santon Downham hoard. Its Belgic technique (especially the enamelling and repoussé) suits the state of affairs among the Parisii in East Yorks. The style, however, rules out the suggestion that it was imported Belgic work. It shows the northern tradition of the Torrs champfrein, but with a debt to the south. In the rosettes it may be thought is an element of the Romanizing convention which can be seen in the Elmswell style. Actually the rosette has a longer history in British art. The occurrence and distribution of the rosette, the relation of the Elmswell panel to the Aesica brooch and other considerations suggest that the panel is the work of an artist on the edge of the Roman world but not yet in it, most probably about A.D. 60, when the Parisii were included in the territory of the pro-Roman Cartimandua, Queen of the Brigantes.

Coral Reefs

FOR long enough coral reefs have furnished food for speculation and interest to naturalists and other men of science. Much has been written on the formation of reefs and atolls but not so much on the living activities of the animals themselves, and yet it is just these activities that determine the nature of the reefs. This aspect of the "biology of reef-building corals" has been dealt with by C. M. Yonge (Great Barrier Reef Exped. Sci. Rep., 1, 1940) in a publication which synthesizes previous work and the author's own observations and experiments. Coral polyps are adapted for feeding upon zooplankton, and the zooxanthellæ they contain play no part in their nutrition; for while the zooxanthellæ are dependent on the corals and do not occur free in the sea the converse is not true and individual coral colonies are not dependent upon the zooxanthellæ. Reef-building corals exhibit a marked phototropism and so light plays an important part in their growth and is indeed responsible for their vertical distribution. Their horizontal distribution is limited mainly by temperature, but other factors incident upon local conditions also play their part. Reef corals are able to get rid of sediment by the action of their cilia, and unattached corals can uncover themselves when buried under sand. The diversity of the adaptional possibilities exhibited by different species of corals determines their position in the reef. The photographs by T. A. Stephenson of the same colony during daylight and at night (taken by flashlight) are illuminating.

Meiosis

FROM the general accounts of meiosis given in text-books a simple and in some respects a misleading picture is obtained. While the final result is the reduction of the chromosome number so that upon fertilization the normal somatic number is restored, the details by which the reduction is brought about vary within wide limits. A review of these variations provided by C. D. Darlington is a useful antidote to the simplicity of the text-books (*Biol. Rev.*, July 1940). There are three main sources of the variations: (1) the place where the pairing chromosomes touch; (2) the time that is available for pairing; (3) the amount of twisting that can be undergone by the portions of the chromosomes which are paired. The material upon which the review is based is from the plant kingdom.

Combined Fertilization and Apomixis

G. Gentcheff and A. Gustafsson (*Bot. Not.*, 1940) have shown that a biotype of *Potentilla collina* forms embryos by parthenogenesis, but that the further development of the embryo cannot take place unless fusion of the central fusion nucleus with a nucleus from another source has occurred to provide an endosperm. In these apomicts the number of chromosomes in the mother, embryo and endosperm does not affect the setting of seed. Treatment with heteroauxin did not influence seed production but did induce parthenocarpy.

Tubercularia Fungi

A VERY detailed paper by T. Petch (*Trans. Brit. Mycol. Soc.*, 24, Part 1, 33–58, June 1940) gives a critical account of the genus Tubercularia as accepted at present. From a bewildering number of species of the genus recorded for Great Britain the author finds only two valid namings—*T. vulgaris* and *T. versicolor*. The former is known to be a stage of *Nectria cinnabarina*, and the latter frequently occurs in company with various species of Nectria, though it is possible that it merely seeks the company of any fungus, having even been found on the stalk of *Polyporus squamosus*. One curious form, previously named *T. granulata*, is shown to be really modified *T. vulgaris*, and *T. nigricans* is parasitized *T. vulgaris*. The question of parasitization of Tubercularias is treated at some length, and forms a useful addendum to the critical part of the paper.

Copper-deficient Australian Soils

THE study of these interesting soils has been continued and a report by D. S. Riceman, C. M. Donald and S. T. Evans (from the Animal Nutrition Laboratory and the Waite Research Institute, Adelaide) is issued as Pamphlet No. 96 by the Commonwealth D.S.I.R. (by the photo-lithographic process as a war-time economy). The main objective is the establishment of superior perennial pasture, but the cereals, particularly oats, have proved the most satisfactory plants in their indication of copper deficiency. Maximum yield of oats and wheat was obtained with application of 14–56 lb. copper sulphate per acre. Further work will show how long the effect of these dressings will last. Analysis of the copper content of the plants in the dressed soils, suggests that other complicating factors are numerous, possibly in some cases the interplay of iron and manganese, but the influence of organic manure may be more effective than liberal applications of copper. It is clear that the heavier crop yields obtained after copper application may reveal further deficiencies in available elements, and in this connexion the supplies of iron and manganese are being closely scrutinized. The two grasses naturally prominent in the copper-deficient soils are *Bromus madritensis* and *Lagurus ovatus*. Apart from an improvement with nitrogen supplied in the spring these species have shown no response to copper or any other fertilizer treatment.

Forest Soils in the Adirondack Section, New York State

IN a paper on "Cation Exchange Properties of Certain Forest Soils in the Adirondack Section", R. F. Chandler, jun. (*J. Agric. Res.*, 59, No. 7; 1939) states that the selection of methods for the determination of exchangeable cations in forest soils required special attention because of the high content of organic matter in certain horizons. The cation as well as the anion in the leaching salt markedly affects the solubility of the organic matter. The ammonium ion is particularly active in this respect, and hence methods should be avoided which involve the treatment of soils with any ammonium salt previous to the determination of total exchange capacity. The research work described has been undertaken in virgin forest soils. This fact may be stressed, for a considerable amount of ecological work in connexion with forest botany and forest soils has been carried out in forest areas the character of which has often been entirely changed, and not unusually degraded, by the action of man himself; misleading inferences leading to harmful economic action having been too often the result. The locality here dealt with appears to offer an excellent opportunity for studying the properties of virgin soils; the object of Mr. Chandler. There are, he says, localities where the climax forest types have not been appreciably disturbed by man or fire; the two most misleading factors when studying the remnants of the natural or pseudo-natural forests about the globe. The paper presents data on the cation-exchange capacity, exchangeable bases, percentage base saturation, percentage loss on ignition, and hydrogenation concentration for soils of similar geological origin but occurring beneath three distinct forest types, namely, red spruce, red spruce – sugar maple – beech, and sugar maple – beech – yellow birch.

Perchlorides of Hydrogen

AN investigation of the freezing point curves of mixtures of chlorine and hydrogen chloride by J. A. Wheat and A. W. Browne (*J. Amer. Chem. Soc.*, 62, 1577; 1940) shows that two compounds separate: HCl,Cl_2, m.pt. − 115° and $2HCl,Cl_2$, m.pt. − 121°. It is suggested that chlorine attached to hydrogen donates a pair of electrons to the chlorine of the chlorine molecule, and the formulæ of the compounds are thus written as: $H—Cl \rightarrow Cl—Cl$ and $H—Cl \rightarrow Cl—Cl \leftarrow Cl—H$.

Chemical Separation of Isotopes

A PAPER was read on this subject by H. C. Urey, of Columbia University, at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The chemical separation of the isotopes of nitrogen and carbon gives the most rapid separation of these isotopes which has so far been devised. Experiments have been made in which three fourths of a gram of C^{13} have been transported per 24-hour period. The simple process fractionation factor for the exchange reaction between ammonium ion and ammonia is 0·967, favouring the concentration of N^{15} in the ammonium ion, while the simple process factor for the exchange reaction between hydrogen cyanide and cyanide ion is 1·025, favouring the concentration of C^{13} in the gas. These rates of production are for laboratory production. There seems to be no reason why the method cannot be extended to plant size apparatus with the production on as large a scale as is required.

WINDOWS AND BOMB 'BLAST'

THE Research and Experiments Department of the Ministry of Home Security has issued two memoranda dealing with the protection of plate glass windows and other large sheets of glass from the effects of bombing. The following points have been extracted from the bulletins.

Effects of Blast

Bulletin No. C.9 is concerned with vertical windows, fixed or made to open, fitted with plate glass $\frac{3}{16}$ in. thick or more. Such windows are common in shop fronts, restaurants and hotels, in internal display cabinets inside or outside buildings. The protection of the interior lit by the window is also considered.

Shop windows are prone to damage by blast because of their large areas. Small panes of plate glass are relatively strong but may fail by the frame breaking. When a bomb explodes the direct blast pressure may force in the window, or the suction following the pressure pulse may pull it outwards. At greater distances reflections of the shock-wave may start strong vibrations in a window which happens to have the same natural frequency. Such a window may break when others close by are unharmed.

The minimum distance from an explosion at which plate glass will escape damage cannot be predicted, but within 200 ft. its chance of survival is small. Beyond that distance the chance depends on factors which include size and thickness of pane, frame fixing, size of bomb and method of detonation and, in particular, the reflection of the blast wave from adjacent buildings. The last factor is chiefly responsible for the apparently freakish fracture of windows. Panes facing the ends of streets leading towards the explosion often break while adjacent windows escape. Where blast travels along a street, the side panes (at shop entrances, etc.) may be broken and the larger front panes escape; elsewhere the reverse may happen.

When a pane breaks under severe blast, pieces may be scattered violently. It is not possible to foretell whether the pieces will fly inwards or outwards. When a pane breaks under distant blast, pieces generally fall inside and outside within a few feet.

Plate glass in internal partitions, show cases, etc., is almost as liable to fracture and to dangerous scattering as glass in external windows. Plate glass in doors, and in sliding or hinged windows, is somewhat less vulnerable. It is desirable to fasten doors wide open during air raids and generally to open windows.

There is no method of preventing the fracture of glass under blast, nor has any method yet been discovered of materially increasing the resistance of glass to blast while retaining its transparency.

Various forms of bracing and damping devices have been investigated but none has been found which can be relied on to strengthen the resistance of the glass. In certain circumstances a bracing device may increase the liability of the pane to fracture. The behaviour of braced windows in air raids has confirmed the investigations. An important objection to such devices is that it may give the occupier of the building a false sense of security, blinding him to the need for providing against the danger of flying glass.

The possibility of increasing the resistance of large sheets of plate glass is being investigated. Research, however, does not at present indicate more than that it is useful to provide a flexible setting for the glass.

Minimizing the Results of Fracture

Since it is not practicable to prevent the fracture of plate glass windows, while retaining their transparency, efforts should be directed towards minimizing the results of breakage. Such results include injury from flying glass, damage to stock or other contents of the building from flying glass and from exposure to weather and, in shops, pilfering of stock and loss of trade.

Shop windows may be covered externally with boarding on stout framing, securely fixed, and provided with hinged shutters over openings exhibiting the display space. Such boarding only gives a slight degree of protection. Rolling shutters of steel or wood give less protection than boarding. Under severe blast they may be dislodged from their guides. Internal damage can be much reduced if a solid brick wall or substantial panelling is built at the back of the window display space.

Wire netting of $\frac{1}{2}$ in. mesh will stop all but the smallest fragments of broken glass; these, except under very severe blast, are not likely to fly far. There is no need to use two layers of netting. The netting should be as close to the glass as possible, preferably touching it. Netting of larger mesh than $\frac{1}{2}$ in. has much less effect in arresting flying glass fragments. A mesh larger than 1 in. may pass dangerous fragments of glass.

Blinds and curtains, particularly if heavy and thick, give a moderate degree of protection against flying glass fragments, except under intense blast.

An adhesive treatment does not make the breakage of glass less likely but, if appropriate to the weight and size of glass, it affords a useful measure of protection against the scattering of fragments. The following "anti-scatter" adhesive treatment is suitable for plate glass $\frac{3}{16}$ in. or $\frac{1}{4}$ in. thick, though it reduces the transparency. A full coat of varnish is brushed on the glass and when it has become tacky a sheet of fabric or strong textile netting is pressed into the varnish so that the whole glass area is covered. When the material is thoroughly set a full coat of varnish is brushed over the whole. Where considerable transparency is required (for example, in display windows) textile strips can be used, though this treatment is not so efficient as a close mesh netting all over the glass. Interspaces between strips should not be more than 6 in. each way. The stronger the textile and adhesive, the better the result. Transparent film of "Cellophane" type pressed into and afterwards coated with varnish is a useful alternative to the fabric or textile netting treatment. Liquid coatings and paper strip are not recommended for plate glass.

GLASS SUBSTITUTES

Bulletin No. C.10 deals with flexible substitutes for glass.

It is pointed out that glass damage from a bomb explosion is always much more widespread than its other effects. The breaking of glass and the violent scattering of its fragments under the blast of high-explosive bombs cause a fair proportion of air raid casualties, and serious inconvenience from exposure to weather. Several 'anti-scatter' treatments to prevent the flying of glass fragments have been recommended in Ministry of Home Security publications, but though such treatments may hold fractured panes together, they neither reduce the risk of breakage nor prevent the pane being wholly dislodged if the blast is violent enough. It appears unwise to replace broken glass with new glass, in view of the risk of repeated attack and because new glass would in turn require protective treatment. Further, supplies of materials for protective treatments can be expected to serve only a fraction of the glass at present in use. The utility of a flexible substitute for glass, that can be harmlessly dislodged by blast and readily replaced, is therefore obvious.

Flexible substitutes may be either translucent or, where permanent obscuration is required, opaque. Most translucent substitutes are at present made of synthetic resins or cellulose substances reinforced with metal or textile mesh. Alternatively, cotton or linen textiles may be used; these are not ordinarily windproof or rainproof, but may be obtained suitably treated with cellulose lacquer or with boiled linseed oil, or alternatively, may be treated in position at the window opening.

Only the stiffer materials, that is, those reinforced with metal mesh, are likely to be suitable for use in roof glazing bars. They should probably be supported below at 2 ft. intervals, as recommended for roof glass in R. and E. Department Bulletin C. 7. No tests have yet been carried out.

For vertical glazing, preliminary blast tests show that if flexible glass substitutes are fixed with nails or staples, the material when displaced is usually torn at the edges. Also where edge fixing is too strong the material may be burst in the centre. Fixing with a soft non-setting putty or mastic, fastening the edges with adhesive tape, fixing by ordinary wood glazing beads in the glass rebates, fixing on the face of the frame by plasterer's lath or similar wood strip, and holding the edges of the material in strip rubber channelling are being tested. It is important that the material should not be wrapped around beads or laths, and nails used to fix such beads should not perforate the edge of the material.

Where permanent obscuration is required galvanized flat sheet steel, composite sheets of asbestos and steel, hard wallboards are suggested for roof glazing. These will stand up to blast pressures considerably greater than those that fracture roof glass. When displaced they can usually be replaced undamaged. They can be fixed in the same way as roof glass. Thinner and more flexible opaque materials such as combinations of wire mesh and bituminous sheeting, soft wallboards, etc., will probably require support from beneath. Experiments have shown that flat asbestos-cement sheeting, including the newer 'flexible' type, is readily fractured by blast; there is, therefore, little to be gained by using it as a glass substitute in roof glazing bars, since it is likely to be fractured before it is displaced, though, when fractured, it is not so dangerous as glass. Wall-boards require painting or impregnation with preservative to give protection against weather.

For vertical glazing, the same materials can be used, and also bituminous sheeting, plywood and plasterboard can be used. The two latter should be painted on the face and on the edges to prevent the soaking in of moisture. A plasterboard faced with bituminous sheet is obtainable.

As with translucent materials, firm fixing, as by nailing, is undesirable.

There are many substitute materials on the market, and a list of twenty-six known to the Department, with names and addresses of manufacturers, is given. The inclusion of a name in the list neither gives nor implies any guarantee by the Ministry of Home Security of the reliability at any time of the price or quality or of the availability of the materials.

BRACING SYSTEMS

Bulletin No. B. 6, issued by the Research and Experiments Department of the Ministry of Home Security, discusses bracing systems for large sheets of glass. The static strength of a sheet of glass, assumed to be subjected to a uniformly distributed load over its whole surface, is increased if a brace is fitted which provides a single central rigid support having an area greater than $A_c = 1/16$ (length of the sheet × breadth of the sheet). If the area of the central rigid support is less than A_c, the strength of the pane is decreased, since the more concentrated forces at the support induce high stresses at that point. If the support is not rigid the strengthening effect is diminished, and so also is the concentration of stress.

If the brace restrains movement at the centre of the pane, the glass between the centre and the edges acquires a natural frequency of vibration higher than that of the pane without the brace. Consequently the equivalent static pressure exerted by the blast on the braced pane is increased. It has been calculated that if the natural frequency of the pane, without a brace, is 10 cycles per second, as with a sheet of plate glass $\frac{1}{4}$ in. thick and 9 ft. square, the effect of fitting a rigid central brace is to increase the equivalent static load exerted by the blast about $3\frac{1}{2}$ times.

In practice, the brace will not act as a rigid support but will always allow some movement of the pane, depending on the tension of the stay wires and their inclination to the pane. The fundamental frequency of the unbraced pane will thus not be entirely eliminated by the fitting of the brace, though vibration of the pane at this frequency will be greatly restrained.

It follows that fitting a more or less rigid support at the centre of a sheet of glass always increases the effective pressure and suction forces exerted by the blast wave, and may or may not increase the strength of the pane. Consequently the effective resistance which the glass can offer to the incident blast wave may or may not be increased. The two effects are opposing and either may predominate, but in no case is the effect likely to be great; in other words, the brace may make the conditions worse or better, but it is not likely to have much effect either way. A brace will not prevent flying splinters of glass after a break occurs.

OILFIELDS OF THE UNITED STATES*

By Dr. Hugh D. Miser,

U.S. Geological Survey

THE modern petroleum industry in the United States of America dates from the drilling of the first commercial oil well in 1859. Up to the present, about a million wells have been drilled for oil and gas, and the total production of petroleum has been 22,452,498,000 barrels, which has been contributed by twenty-three of the forty-eight States.

Statistics of the supply and demand of crude petroleum and refined products for the United States for 1939, as published by the Bureau of Mines, United States Department of the Interior, are:

	Thousands of barrels.
Domestic production (crude petroleum)	1,264,256
Imports (crude petroleum)	33,095
Imports (refined products)	25,804
Exports (crude petroleum)	72,073
Exports (refined products)	116,909
Domestic demand (refined products)	1,228,069
Total demand (crude petroleum and refined products)	1,417,051

Much is known concerning the geology of the oilfields of the United States, and additions to our geological knowledge of them are being made continually by the 3,000 or more petroleum geologists in the country. Data on the structure and stratigraphy of the oil-bearing rocks are supplied in large measure by the wells that are drilled for oil and gas and also by geophysical methods of exploration. Many of the wells exceed 10,000 ft. in depth and the deepest, which was completed in 1938 in California, reached 15,004 ft. The depths explored by geophysical methods exceed 30,000 ft.

The oil-bearing rocks of the United States are widely distributed and are of many different ages. They occur in all parts of the geological column from the Ordovician to the Pliocene. The common reservoir rocks are sand, sandstone, limestone, dolomite, and chert.

The relation of oil to geological structure was noted so early as 1860 in the United States, but oil companies did not employ great numbers of geologists before the present century, when the demand for petrol increased rapidly because of the growing number of motor-vehicles.

Anticlines were first sought as favourable structural features on which to locate drilling sites for oil; but, with further drilling and the consequently increased knowledge of the occurrence of petroleum, it was learned that oil pools are associated with many other types of structural features, which include faults, salt domes, and buried hills. In addition, oil reservoirs like those of the east Texas field in Texas and the Coalinga and Midway-Sunset pools in California belong to a type recently designated as stratigraphic traps. Such reservoirs may be due to lensing, to unconformities, and to various lateral gradations in porosity and permeability of the reservoir rocks.

Estimates of the proved reserves of petroleum in the United States at the beginning of 1940 range from 18,500 to 19,700 million barrels. The estimates include the amount of petroleum recoverable by current methods of production from pools already proved by drilling. They do not include the as yet unknown amounts of petroleum that will be discovered in the future in new fields or in deeper zones or extensions of the present producing fields.

With the greatly increased depths to which wells have been drilled in recent years, the proportion of oil reserves found at the greater depths has increased. The first production below 10,000 ft. was obtained in 1935 at Binger, Oklahoma, where the output has averaged 30 barrels per day. During 1937–39 substantial amounts of oil between 10,000 ft. and 13,266 ft. have been discovered and developed in forty fields, of which eight are in California, five are in the Gulf Coast region of Texas, and twenty-seven are in the Gulf Coast region of Louisiana.

---

* Abstract of a paper presented, by permission of the Director of the Geological Survey, United States Department of the Interior, to Section III (Geological Sciences) of the Eighth American Scientific Congress.

EARTHQUAKES AND STRUCTURES

UNDER this title, there is published in the *Journal of the Royal Society of Arts* (August 23, 1940) the text of a paper read by Mr. D. Laugharne Thornton in which he gave an account of the salient features to be observed in the design of structures for regions subject to earthquakes. Mr. Thornton, an authority on vibration, has treated the behaviour of earth waves in his recent book "Mechanics Applied to Vibrations and Balancing". The subject of his paper was primarily of interest to engineers, to whom the problem set by earth phenomena is how to mitigate the great loss of life and property attendant on them. It concerns also those charged with public safety, to whom several of his inferences and conclusions are likely to be of moment, such, for example, as the care which must be taken to ensure that the form of structure, the choice of materials, and the nature of the loading permitted must be adapted to the local conditions.

On the engineering side, the matter is one of dealing with stresses of great intensity and with materials in which the seismic waves suffer so little damping that they may be felt hundreds of miles from the epicentre. In general, the information gathered by seismologists does not satisfy the needs of the engineer, who requires data regarding 'near' earthquakes, for it is in the vicinity of the disturbance that the destructive effects on buildings occur. To this end, instruments would require to be placed on the foundations as well as in the principal parts of a structure during an earthquake so that their records would help in the interpretation of the results of experiments made on models attached to 'shaking tables'.

Mr. Thornton gave much detailed information about the nature and causes of the destruction which occurred in the earthquakes at Quetta, Anatolia, Antiqua and elsewhere, and discussed the effects produced on different buildings. The immediate consequences on foundations depend on the elastic properties of the subsoil, and the wide range of the values of these was shown in a table giving the velocity of compressional waves in typical strata. The effects of faulty distribution of loading were pointed out, the danger of heavy roofs, the general advantage of light rather than heavy construction, and the need for good material and workmanship and strictly appropriate design. In conclusion, he emphasized the need for more information regarding earthquakes, and suggested the collaboration of seismologists and engineers in examining the problems by means of records taken by instruments suitably designed for the purposes of both.

THE TRANS-CANADIAN HIGHWAY

THE last western link in the Trans-Canadian highway—the Big Bend section in the Revylstoke district of British Columbia—was opened officially by the Premier of British Columbia, Mr. T. D. Patullo, a few weeks ago. The road provides motorists for the first time with an all-Canadian direct route from the prairies to the Pacific coast. The ceremony took place at Boat Encampment, where David Thompson first saw the Columbia River and began its exploration in 1906.

Roads and Road Construction of September 22 states that the completion of a Trans-Canadian highway, long the dream of Canadians, who have to motor through the United States to get to Manitoba from Ontario, may await the end of the War, although only a small stretch now remains uncompleted. Two highways are proposed in north-western Ontario, either of which would, when completed, constitute the final link between British Columbia and Nova Scotia, but according to a statement made by Mr. R. M. Smith, Ontario Deputy Highways Minister, "it depends on the War when we can get back to heavy work on the projects". He added that War-time economics have cut down capital expenditures to almost nothing and stated that the date on which work can be resumed is indefinite.

The route most likely to be completed first is the far northern one, on which about two hundred prisoners housed in road camps are at present working between Long Lac and Hearst. The work involves about 135 miles, and from about a million to 1½ million pounds will be necessary for the completion of the work after the prisoners have cleared the land and undertaken preparatory work.

The other route, on which constructional work was suspended in 1936, lies between Schreiber, on the north shore of Lake Superior, east to White River, and south-east to the Montreal River, in the Timiskaming district, a distance of approximately 250 miles. The Deputy Minister estimated that completion of the work will cost between five and six million pounds.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GRADUATE IN ENGINEERING at the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (October 2).

LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governors, Derby Technical College, Normanton Road, Derby (October 5).

RESIDENT TUTOR—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (October 5).

TEACHER OF ENGINEERING SUBJECTS—The Principal, County Technical College, Gainsborough, Lincs.

DOMESTIC SCIENCE MISTRESS, and a SCIENCE MISTRESS (BOTANY AND BIOLOGY), for a Boarding School in Cape Province, South Africa—The Education Section, Society for Overseas Settlement of British Women, 16 Northumberland Avenue, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22, (N.S.), No. 31: Salmon of the Ballisodare River. 1: History of the Ballisodare Fishery. By Arthur E. J. Went. Pp. 289–306+plate 7. 2*s*. 6*d*. Vol. 22, (N.S.), No. 32: Soil and Fresh-Water Iodine-Content in Ireland in relation to Endemic Goitre Incidence. By James C. Shee. Pp. 307–314. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [59

New Leadership. By Garth Lean and Morris Martin. Pp. 22. (London: William Heinemann, Ltd.) 3*d*. [109

King's College: Dove Marine Laboratory. Report for the Year ending July 31st, 1939. (Third Series, No. 7.) Pp. 32. (Cullercoats: Dove Marine Laboratory.) [109

Éire: Roinn Talmhaidheachta (Department of Agriculture): Brainse Iascaigh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1938. (P. No. 4055.) Pp. 36. (Dublin: Stationery Office.) 9*d*. [109

Tyneside: the Social Facts. By Dr. David M. Goodfellow. Pp. 80. (Newcastle-upon-Tyne: Co-operative Printing Society, Ltd. 1*s*. [179

Medical Research Council. War Memorandum No. 2: Notes on the Diagnosis and Treatment of Gangrene; with a Suggested Scheme for the Bacteriological Investigation of War Wounds. Pp. ii+14. (London: H.M. Stationery Office.) 3*d*. net. [179

Other Countries

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 74, Abh. 1: Geologie des Voirons. Par Dr. Augustin Lombard. Pp. vi+112+5 plates. (Zürich: Gebrüder Fretz A.G.) [29

Smithsonian Institution: United States National Museum. Bulletin 175: Variations and Relationships in the Snakes of the Genus Pituophis. By Olive Griffith Stull. Pp. vi+225. (Washington, D.C.: Government Printing Office.) [29

N.Z. Department of Scientific and Industrial Research: Christchurch Magnetic Observatory. Annual Reports for 1934, 1935, 1936. Pp. ix+132. (Christchurch: Magnetic Observatory.) 7*s*. 6*d*. [39

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 97: The Shrinkage of Australian Timbers. 2: Shrinkage Data for 170 Timbers. By W. L. Greenhill. (Division of Forest Products: Technical Paper No. 35.) Pp. 48. Pamphlet No. 98: The Prevention and Treatment of Blowfly Strike in Sheep. Report No. 2 by the Joint Blowfly Committee. Pp. 48. (Melbourne: Government Printer.) [59

Ceylon. Paper 4: Education, Science and Art (F). Administration Report of the Acting Director of the Colombo Museum for 1939. By P. E. P. Deraniyagala. Pp. F16. (Colombo: Government Record Office.) 15 cents. [59

Ministério da Educacao e Saude. Anuário publicado pelo Observatório Nacional do Rio de Janeiro para o ano de 1940. (Ano 56.) Pp. xiii+460. (Rio de Janeiro: Observatório Nacional.) [59

N.Z. Department of Scientific and Industrial Research: Apia Observatory, Apia. Annual Report for 1936. Pp. iv+143. 6*s*. Annual Report for 1937. Pp. iv+131. 6*s*. (Wellington: Government Printer.) [109

U.S. Department of the Interior: Office of Education. Bulletin 1939, No. 9: Residential Schools for Handicapped Children. By Elise H. Martens. Pp. vi+103. (Washington, D.C.: Government Printing Office.) 15 cents. [109

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1939. (No. 71.) Pp. 125+5 plates. (Adelaide: Government Printer.) [109

Report on the Progress of Broadcasting in India up to the 31st March 1939. Pp. xiv+230+21 plates. (Delhi: Manager of Publications.) 3 rupees; 5*s*. [179

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Acting Marine Biologist for the Year 1939. By P. E. P. Deraniyagala. Pp. G9. (Colombo: Government Record Office.) 10 cents. [179

Forest Research in India and Burma, 1938–39. Part 1: The Forest Research Institute, Dehra Dun. Pp. iii+111. (Delhi: Manager of Publications.) 2.14 rupees; 4*s*. 9*d*. [179

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 5, 1940 No. 3701

EVACUATION AND EDUCATIONAL POLICY

THE well-balanced report to the Fabian Society which has been edited by Richard Padley and Margaret Cole under the title "Evacuation Survey" is the most comprehensive of a number of admirable reviews of the situation which have already appeared.* Besides the investigations carried out by the Department of Social Science of the University of Liverpool and the articles in the *Quarterly Review* and the *Political Quarterly* which have already been commented on in these columns, there are Lady S. D. Simon's "The Children in War-Time" issued by the Workers' Educational Association and a further study "Evacuation: Failure or Reform" by F. Le Gros Clark and R. W. Toms, also issued by the Fabian Society.

The main impression which Mr. Padley and Mrs. Margaret Cole's report leaves is the lack of vision and co-ordination in the original planning. The absence of these was the prime cause of the confusion and difficulties which went far to wreck the original scheme and did the greatest mischief to the educational system. Until that position has been rectified it is idle to expect the firm action which is still required to bring order again into the field of education and prevent the perpetuation of damage to health and educational services alike.

On this point the criticism of the Government is sharp and severe. Confusion of thought appears to have characterized the conception of the scheme as well as its execution. Circulars issued by the Ministry of Health instructing the local authorities how to deal with evacuation problems convey the impression of a Government using the decentralized local government system, not as a means of making allowances for local needs and resources, but rather as a method of shirking its own responsibility. Difficulties are admitted with no long-term programme for their solution. Heavy burdens of organization are placed on small local authorities, ill-equipped for such detailed administration. Voluntary effort is continually relied on to provide services which the Government is unwilling to organize or finance.

Of the Departments concerned with administrating the scheme, the Board of Education, which alone showed sufficient imagination, was lacking in initiative, and allowed itself to be refused any major share of control. The Ministry of Home Security was obsessed with the prospect of destruction and too busy with other aspects of civil defence. The Ministry of Transport saw the whole thing purely as a technical problem; and the Ministry of Health, which was responsible for the scheme, was far too timid to develop any serious policy. Over them all was the control of a parsimonious Treasury, which correctly interpreted the Government's attitude in resisting the expenditure which would have been necessary to assist the local authorities in offering proper services for the evacuees.

The survey does not suggest that any of the steps which the Government neglected would, in the absence of the heavy bombing which was expected, have made a complete success of the scheme. The shrewd and severe criticism, however, makes it very plain that with efficient planning and proper co-operation between the many local authorities and services the scheme would have come much nearer to achieving success. The Ministries at the centre failed to supply the wise and energetic guidance that was essential, and it is well that we should remember that the considered judgment of the first evacuation scheme leads inescapably to the conclusion that the Civil Service, through lack of vision and constructive ability, missed an immense opportunity.

---

* Evacuation Survey: a Report to the Fabian Society. Edited by Richard Padley and Margaret Cole. Pp. viii+296. (London: George Routledge and Sons, Ltd., 1940.) 10*s*. 6*d*. net.

Sobering as are the reviews of the national scheme and the experiences of its working in different districts, or of the effects of the scheme on local administration or the various social services which are contributed to this volume, its main outlook and criticism are not retrospective or negative, but constructive. An opportunity was missed because, Mrs. Cole remarks, the scheme was unattractively drawn up "by minds that were military, male and middle class". They were not imaginatively alive to the real issues, human and social, underlying what was to them a mere matter of civil defence. The great value of this book is that it directs attention to the opportunities which are still before us and indicates some of the factors which require weighing and analysis.

The note of vision which characterizes the third part of the book in reviewing the outstanding problems of evacuation enables it to make a real contribution to those important aspects of education and juvenile and adolescent welfare which are with us as part of our war effort and as part of the social reconstruction which must proceed during, and not merely after, the War. The startling disparities between outlook and social habits and conditions which have been revealed to many for the first time by the evacuation have indeed to some extent loosened some of the former obstacles to reform. With a wide vision and a firm but sympathetic handling of these problems, much might yet be done to consolidate the solid gains in health which have in some districts already resulted, and to retrieve the mistakes which parsimony or sheer administrative incapacity have perpetrated. Success can only come when not merely the House of Commons but the whole country acquires a real interest in education and in the contribution to the national welfare which the school social services represent.

It is only possible to select a few of the possibilities for mention here. To take education in its narrowest sense in the first place, the outbreak of systematic bombing attacks with a main objective in the disintegration of civilian morale makes the provision of an education as complete as possible a matter of vital defence as well as a desirable end of statecraft.

It must be recognized that not all the dislocation of education has come from evacuation ; but there can be no question that the time has come when full educational facilities must be restored. Even if the whole time is not spent in a school, full-time education can and must be provided both in the reception and in the evacuation areas. Moreover, it is remarkable that the importance of bringing immediately into operation the Education Act of 1936, which raises the school-leaving age to the end of the term in which the child becomes fifteen, is now being urged not only by education authorities but also by other bodies of widely divergent interests.

The development and prosecution of an adequate education policy in this way involves naturally some reorganization and co-ordination. It will not be sufficient to hand over to the Board of Education all problems connected with the evacuation and billeting of children, including nursery school children, or to return immediately to the local education authorities all school buildings which are not absolutely indispensable for purposes connected with the War. Imagination and courage and real determination as well as administrative efficiency will be demanded of the Board of Education if it is to execute the required policy with success. No longer must the Board allow itself to be treated as a poor relation and overridden by other Departments.

The question of accommodation supplies an admirable instance in point. If the scheme at present operating is to succeed at all, it must have available not merely accommodation such as billeting premises but also adequate premises for teaching. A general survey of existing premises, which might well yield much of the accommodation required for all purposes, is urgent. Preliminary examination in some of the reception areas indicates that premises are certainly to hand which could frequently be used without drastic alteration. Wise and inspired improvisation could undoubtedly better the situation.

Besides this the question of new building construction must be faced. Here it must be remembered that new buildings are permanent and change the face of the villages and small towns. They must therefore be designed to meet the future needs of the people in the villages and towns as well as the immediate situations. School buildings in many rural areas are hopelessly out of date, apart from their inadequacy to meet the situation arising out of evacuation. The policy of building senior schools in the countryside needs reviving and implementing. Moreover, where premises are lacking or inadequate and no fresh school building has been constructed this situation could often be met by the construction of some type of hall or village centre, which could serve for teaching purposes during the War and afterwards be an asset to the neighbourhood.

The educational position arising out of evacuation abounds in such possibilities of harnessing immediate necessities to future needs and developing national assets rather than frittering away resources in improvisations. What is essential is far-sighted planning and bold leadership inspired by the conviction that a nation's youth is one of its greatest assets, and the wise training of the children and adolescents a sure safeguard of its morale. Only such a conviction will supply the drive essential to carry through the measures required to safeguard the health of the children whether in reception or evacuation areas, to ensure that the diet of the children of the nation is kept at a level affording at least adequate protection against the deficiency diseases, and sufficiently fortified by a good standard of nutrition to be resistant to epidemic infections, thus preserving us the invaluable asset of a healthy and well-developed young generation.

No less determination will be needed to repair the havoc already wrought in secondary and higher education. Here, as Helen Bentwich points out, apart from the acute difficulties imposed by the absence of suitable premises and equipment, billeting offered particular difficulties. In the absence of careful planning of billeting in relation to the actual educational facilities for secondary education in the reception areas, efficient teaching of these children proved almost impossible. Here the evacuation experience endorsed the importance of further regional co-operation in the direction suggested both in the Hadow Report and in a subsequent P E P broadsheet on the control of education.

This Evacuation Survey makes many other admirable suggestions. The chapter on psychological aspects is particularly valuable not only in respect of the warning it gives in regard to juvenile delinquency if we fail to handle wisely the question of small children and separation from their homes, but also in regard to camps and to the needs of parents or foster parents. Some teachers might well consider whether they could not relieve foster parents of some of their heavy responsibilities out of school hours. There are emotional as well as economic problems in evacuation, and the original scheme broke down mainly on the human and domestic side. The vagaries of human relationships were insufficiently considered. Unless the State shoulders its responsibilities in these matters the opportunities for constructive work which evacuation offers will be missed as will the opportunities before the National Youth Committee.

The question really before us is whether we care sufficiently for the welfare of youth to put into its training the thought and effort which are required to meet these new opportunities. A consciousness of the importance of youth as a national asset may provide the first stimulus. Equally our plans must provide for the throwing up of leaders, and for the means by which youth can play its part not only in the national effort now but also in the development of a new social order after the War. This evacuation survey, for all its trenchant criticism of past mistakes or ineptitude, demonstrates emphatically the opportunities still confronting us in social reform in this field of education. If these opportunities are firmly seized, evacuation may yet leave the country a heritage of camp schools, village halls and clubs, nursery hostels and the like such as it has never before enjoyed. Permanent links might be established between urban and rural communities, and a sense of the values of right feeding, of air and sunshine, of child nurture and of social enterprise carried to half the homes of Britain.

To achieve this we need indeed central direction imaginatively alive to these human and social issues, and making wise and effective use of the administrative systems already available. Such direction is needed to ensure due co-ordination not only of the work of the different Government departments but also of such activities as those of the National Youth Committee and the numerous voluntary organizations concerned with the welfare of youth. We need, too, a large and wholesome display of local initiative, exploring and discovering its own solutions for difficulties as they are encountered. Supported by an increasingly enlightened public opinion we may see at last the actual beginning of compulsory day continuation schools until the age of eighteen, the elimination of some of the anomalies of local administration which have hindered the development of our educational system and the implementing of the constructive proposals of the Spens Report and of the provisions of the Fisher Act placed on the Statute Book at the end of the War of 1914–18.

A ZOOLOGY FOR STUDENTS

A Text-Book of Zoology
By the late Prof. T. Jeffery Parker and the late Prof. William A. Haswell. Sixth edition. 2 vols. Vol. 1. Revised by Dr. Otto Lowenstein. Pp. xxxii+770. (London: Macmillan and Co., Ltd., 1940.) 36*s.* net.

IT is nearly forty-three years since "Parker and Haswell" first appeared, and its usefulness has made it about the best-known text-book of zoology of its scope in the English language. During the interval much water has flowed under the bridge, and while five editions have appeared each of them has contained only relatively minor alterations. As is stated in the introduction to the present, that is, the sixth edition of vol. 1, "it was clear that this had to be based on a thorough revision of both text and illustrations". One looks forward to renewing the acquaintance of a friend of such long standing with mixed feelings; pleasure in old friendship and trepidation that the years may have wrought such changes that the friend will no longer be recognizable. The fear may be set aside, for it is the old friend though mellowed and may we say improved with acquired knowledge. Some of the old faults are still present, for example, on p. 1, Linné did not introduce the "binomial" but the binominal nomenclature, and it is preferable to regard the *specific name* as composed of two words, the *nomen genericum* and the *nomen triviale.* The same breezy lack of uniformity is retained in the legends of the illustrations; for example, pp. 400 *et seq.*, we find the same animal referred to indifferently as *Astacus fluviatilis*, *Astacus* or the crayfish. Sometimes this occurs at the beginning of the legend, at others after a preliminary phrase. There is similar diversity throughout: the generic name alone is given or the specific name; either may be in heavy type or in ordinary type or in brackets; the author's name is given in heavy type, in ordinary type, or, more frequently, omitted altogether. This treating of nomenclature as if it were a matter of indifference, while characteristically English, is unnecessary, and in a book that is bound to be used by many young zoologists it would have been as well to have followed a more consistent course.

The first edition contained 752 pages of text and 663 figures while the present one has 744 pages and 732 figures and a larger type has been employed. In spite of fewer pages and larger type, however, the use of a larger page and the elimination of a certain amount of material, now obsolete, has allowed of the inclusion of more useful material. Of the text-figures about eighty are replacements, and since they have been chosen from a much wider range than was available forty years ago each of them constitutes an improvement. The new figures, about seventy in number, similarly add much to the usefulness of the new edition. The book appears to be remarkably free from actual errors or slips, although in the diagram of the eye on p. 36 anterior and posterior chamber are not used in the sense in which they are employed in standard text-books of anatomy—a common fault in text-books of zoology. Posterior chamber is the space between iris and lens capsule and not the cavity containing the vitreous body. On p. 207 "ora uricles" is an obvious slip for auricles. It is scarcely correct to describe *Hirudo medicinalis* as the common British species (p. 355). In a few places also another terminology might be preferred, for example, "unsymmetrical" (p. 154); the terms polype instead of polyp and zoophyte instead of hydroid in the chapter of Coelenterata sound old-fashioned. On p. 324, "deric epithelium" might well have been left as epidermis, and on p. 330 receptaculum seminis might have been left as spermatheca, since receptaculum has a different significance when applied to receptaculum ovorum.

Changes have been made in the classification which were much needed. The giving up of the old "phyla" Nemathelminthes, Trochelminthes and Molluscoidea are steps in the right direction, for the inclusion of the various groups of animals in these phyla suggested a closer relationship than is borne out by their structure. The removal of the Endoprocta, that is, Calyssozoa, from the Bryozoa and the reclassification of the Insecta are more in consonance with modern views and are improvements, as is the more distinct separation of the Chilopoda (centipedes) from the Diplopoda (millipedes). On similar lines it would have been preferable to separate Hydra and its immediate allies more distinctly from the Hydrozoa.

It is easier in a review to direct attention to the faults of a book than to enlarge upon its virtues, and this is the more so in a new edition where past virtues are taken for granted. The present volume is still easily recognizable as "Parker and Haswell" and so characterized by straightforward, concise but nevertheless readable text and it is illustrated by clear, illuminating text-figures. On the technical side it maintains or rather exceeds the high standard set by the first edition, and those who are familiar with the latter will recognize that this in indeed praise. On the whole a praiseworthy judgment has been exercised in what has been included and what omitted, and also between the old "Parker and Haswell" and the changes necessitated by more modern ideas in zoology. The book is intended for the general student who studies zoology, whether in the university or elsewhere, for two years or so beyond the general first-year course. For this purpose it is excellent and will doubtless maintain the success of its predecessor and enhance its fame.

C. H. O'Donoghue.

A HISTORY OF BIOLOGY

Biology in the Making

By Emily Eveleth Snyder. Pp. xii + 539. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 18*s*.

How is it that we know so much of the structure and life habits of dinosaurs and other prehistoric monsters? Why is it that scurvy, the eighteenth century scourge of seamen and others is scarcely known to-day? How was the relationship between insects and diseases discovered? How did Mendel discover the now well-known laws of heredity? Why is it that to-day surgery is comparatively safe whereas at one time about 90 per cent of the patients died of blood-poisoning?

These are only a few of the many questions in biology and such allied sciences as agriculture, medicine and hygiene which might easily be asked by almost anyone, and the teaching of biology will not be perfected until it makes it possible for almost any secondary school student to answer them. The answers can only be found by studying the history of the science. This view is obviously held also by Miss Snyder, and she has given her valuable aid to teachers and students in a book of absorbing interest by means of which they can trace the development in biological discovery, not by so many facts but (as she says) "as the product of real men whose lives for one reason or another make them outstanding in their fields".

The text is written with such compelling style that it is not necessary to have any former knowledge of biology in order to follow the history of biological discovery. The illustrations are a novel feature of the book. Nearly a hundred portraits of biologists and medical men adorn the pages. Some are especially pleasing studies and many have, so far as we know, never been reproduced in a text-book of this standard before. They range from Aristotle through such well-known men of cience as Leeuwenhoek, Linnæus, Lyell, Agassiz, Darwin, Pavlov, Galton, Bateson and Ross to the more modern workers such as Davenport, Gowland Hopkins, Conant, Blakeslee, A. V. Hill, Starling, Banting, Sherrington, Carrel, and so forth. The inclusion of the work and portraits of so many present-day workers marks the book as a distinct contribution to biological teaching. In the past few years, commendable efforts have been made to bring in the outstanding points of the history of any science by means of portrait studies; but most books seem to shun including the study of outstanding present-day workers. Other illustrations also do much to give the subject life and emphasize humanistic features of biological science. Some taken at random are: Gesner in his museum; Linnæus in his garden; consulting room of a physician of the Middle Ages; Jenner vaccinating a boy; Pasteur in his laboratory (the author stimulates the imagination in this case by reproducing the artist's impression of Pasteur in his laboratory and also a photograph from the film in which Paul Muni took the part of Pasteur; it is a pity these two are not on facing pages, since one is very much struck by the faithful reproduction in the film version); surgeon of the eighteenth century; Hales's experiment at Newgate Prison; Beebe's bathysphere.

Hints for further reading are given at the end of every chapter. At the end of the book there is a chronological list of nineteen pages. We think this would have been more valuable for reference had it been alphabetical instead of chronological. This list is followed by a glossary and the glossary by an extensive bibliography.

Many non-biologists will find this book of absorbing interest, but we would strongly recommend it to all teachers of biology in schools. Those students who have read a good School Certificate text-book in biology and this book simultaneously will leave school with a very broad outlook on biology and its important applications to human life and affairs.

TRENDS IN MATHEMATICAL BIOLOGY

(1) Mathematical Biology

By V. A. Kostitzin. Translated from the French by Theodore H. Savory. Pp. 238. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1939.) 7*s*. 6*d*. net.

(2) Advances and Applications of Mathematical Biology

By Nicolas Rashevsky. (University of Chicago Science Series.) Pp. xiii + 214. (Chicago: University of Chicago Press; London: Cambridge University Press, 1940.) 12*s*. net.

(1) RARELY is a scientific text-book translated from French into English, and one feels that in translating this volume from the well-known "Collection Armand. Colin", Mr. Savory has issued a challenge to English biologists to make a better acquaintance with recent applications of mathematics to biology. This excellent translation is certainly of value in directing attention to a book which, according to Dr. Volterra, marks an important date in the progress of mathematical biology. The major part of the book deals with the problems of biological associations and the struggle for existence—problems which, with the help of simple and rather plausible assumptions, can be expressed as first order differential equations. The first ten chapters discuss the solution of these equations. They summarize the pioneer work of Lotka and Volterra on population growth and relations between species, including symbiosis and parasitism; and many of their results are generalized and extended, while the author's critical discussions are always of value.

Among points of particular interest are the ingenious use of Gause's data on cultures of Paramecium to give a further verification of the logistic law (Chapter iv), a plausible attempt to explain sudden fluctuations in numbers of small rodents (Chapter v), and the study of 'residual action' in Chapter viii (cf. Volterra's 'historical' actions). Chapter ix contains an excellent analysis of predator-prey relations and the failure of Volterra's 'classical' fluctuations to represent experimental fact; but further discussion of Gause's 'relaxation' oscillations would have been welcome, and there is no mention of Bailey and Nicholson's theoretical study of balance of populations (*Proc. Zoo. Soc. Lond.*, 551; 1935). The remaining chapters, on growth, the forms of living objects and selection, are of less interest; and in particular the assumptions used to develop equations for embryonic and postnatal growth are open to criticism, while the theory of 'superficial excrescences' (pp. 212–14) is not convincing.

The treatment of the book is rather too didactic for so speculative a subject, and the arguments are at times obscure because over-terse. The mathematical notation is difficult but remarkably concise. Experimental analysis of biological associations is clearly urgently needed to test M. Kostitzin's mathematical predictions and the assumptions upon which they are based. Here is plenty of scope for the experimental biologist, and repetition and extension of Gause's pioneer work in this field would be of particular value.

(2) This is a sequel to Dr. Rashevsky's "Mathematical Biophysics" (Chicago, 1938), and describes recent progress in this field. In the first six chapters a new approximation method is developed for studying diffusion in a highly abstract, isolated and homogeneous 'cell', which is no longer spherical, and the results are applied to cell respiration, division and growth, cell forms and movements, and protoplasmic streaming. The new method consists in simplifying the cell beyond all recognition and then dealing only with orders of magnitude, and cannot be expected to throw much light on the complex phenomena of cellular physiology. Nevertheless, the author has followed up his postulates with remarkable ingenuity, and his conclusions are of interest because they show a certain relationship to experimental fact and suggest new lines of research.

In the abstract system under study, diffusion outwards generates forces which tend to round up a small cell but to elongate a large cell, and above a certain critical size these forces may overcome the opposing surface tension and lead to cell division or a non-spherical state of equilibrium. This critical size is found to be of the order of magnitude of actual cells. Since diffusion inwards has an opposite effect, the resultant forces generated by the substances produced and consumed in metabolism may decide whether the cell will divide. It appears that the critical size should be proportional to the inverse cube-root of the oxygen-consumption rate, a conclusion for which slight experimental evidence is adduced, while a high glycolytic coefficient should increase the readiness to divide. The nucleus is dismissed as a "local structural detail". The theory that rapidly dividing tumour cells have an abnormally high glycolytic coefficient suggests a theory of growth (Chapter iv); but this discussion loses much of its interest in view of recent work by Boyland and Boyland (*Biochem. J.*, 33, 618; 1939), who found little correlation between growth-rate and glycolysis in different strains of grafted tumours. Study of cellular forms and movements suggests that non-spherical cells should round up after death, and experimental evidence on this point and on the effect of various drugs on cell shape would be of great interest.

The remaining chapters summarize the author's abstract mathematical theory of the functions of the central nervous system, and discuss excitation and inhibition, reaction times, discrimination of intensities and perception of visual patterns. This work is still highly conjectural, but the conclusions reached connect up to some extent with experimental evidence.

Dr. Rashevsky's method of analysing mathematically the behaviour of abstract systems from which all irrelevant complexities have been eliminated has been so successful in physics that it holds out promise in biology; but the problems are here more difficult and we are still very far from the systematic mathematical biology which the author envisages. E. C. R. Reeve.

GEOMORPHOLOGY

Geomorphology

An Introduction to the Study of Landscapes. By Prof. A. K. Lobeck. Pp. xii + 731. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 25*s*.

A Textbook of Geomorphology

By Prof. Philip G. Worcester. Pp. viii + 565. (London: Chapman and Hall, Ltd., 1939.) 22*s*. 6*d*. net.

THE increasing use of the word 'geomorphology' may be regarded as symptomatic of the emancipation of the science from parental control; for as a hybrid science, the offspring of geology and geography, its early footsteps have hitherto been guided in the direction dictated by one or other of its parents, so that it was either 'physical geography' or 'physical geology'. Now the science has its own journal, less than two years old, and a rapidly growing literature which is steadily developing its own technique, and a personality quite distinct from its parents.

In the two books under review the subject-matter is much the same but the treatment differs vastly; it may be said that while Prof. Lobeck is a geomorphologist, Prof. Worcester still follows the tradition of physical geology. While both explain the operation of weathering and erosion in shaping the features of the earth's crust, the latter is concerned mostly with the 'process' and the former with the 'product' at each stage in an evolutionary process, tracing, with delightful clarity, the development of land-forms from youth, through maturity to old age in each structural type and under each denudational process.

In both books is recognized the importance of illustration as an aid to description, for words alone can never adequately portray the subtle but significant variations of form in landscape. Prof. Worcester relies mainly on the photograph, supplemented by line drawings, but Prof. Lobeck brings to bear his great skill as a draughtsman and uses the block-diagram to isolate and demonstrate the physiographic essentials of a landscape. These are not simply illustrations, but are, as it were, an essential part of the text, built into it and amplifying it.

Though unnumbered, there are about five hundred of these, varying in size from 4 sq. in. to full-page drawings, and, in addition, each chapter is introduced by about a dozen beautiful photographs, illustrating the land-forms to be described in that chapter. In this way the unnatural simplification of the idealized block-diagram is corrected by the view of the actual scene, but the diagram, in its turn, analyses and explains the landscape. Treated in this way the block-diagram becomes a most effective instrument for teaching, and it is in this function that Prof. Lobeck excels. There is an early chapter, too, on scientific method and presentation which is very helpful and suggestive to teachers and learners alike. The striving after clarity, simplicity and mental tidiness sometimes leads the author into the error of excessive orderliness in what is, after all, not an exact science; as an example we may quote his recognition of 'mature stages' in each evolutionary series of land-forms; these are always carefully defined, but the definition is often highly arbitrary and not always generally accepted.

Prof. Worcester's book is much more conventional and follows the high traditions of such standard works as Salisbury's "Physiography".

A. A. Miller.

ELECTROMAGNETIC THEORY

Static and Dynamic Electricity

By Prof. William R. Smythe. (International Series in Physics.) Pp. xviii+560. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 40*s*.

FOR some time there has been a crying need for a standard text-book on electromagnetic theory, which should give a concise summary of its fundamental principles, and should illustrate them by abundant reference to problems of practical physics and technical engineering. The classical treatises by Jeans and Livens give admirable accounts of the basic laws of electromagnetism, of the mathematical analysis required in problems and of the semi-philosophical problems which lie at the root of the speculative parts of the theory. But it was not their aim to deal in any detail with practical applications or to present the results of the theory in a form adapted for use in research. This magnificent text-book by Prof. W. R. Smythe has as its express object to exhibit the theory of electricity and magnetism in direct relation to problems of research.

The reviewer has used this book in connexion with a variety of practical problems since its publication last November and has never met with disappointment. Every possible aid to the research worker has been given by the author, even to the detail of noting at the foot of each page the system of units employed thereon. The results are always given in the most practical form. Thus, for example, the magnetic field due to a circular loop is not expressed as a useless, slowly convergent series of zonal harmonics but as elliptic integrals which can be rapidly evaluated from tables.

There is a twenty-page index and a careful appendix comparing in detail the standard systems of units. Vector notation is employed throughout. There is a good introduction to the special theory of relativity and also to wave mechanics. The requisite mathematical analysis is developed as required, but space is saved by referring the student to standard tables of integrals for the more elementary results. This treatise should take its place with those of Jeans and Livens as an indispensable help to every research worker in electromagnetic theory.

G. TEMPLE.

INDIAN PHILOSOPHY

A History of Indian Philosophy

By Dr. Surendranath Dasgupta. Vol. 3. Pp. xiii+614. (Cambridge: At the University Press, 1940.) 35*s*. net.

ALL those who are interested in Indian philosophy, and especially the readers of the first two volumes of this excellent standard and scholarly work, will welcome the publication of the third volume as well as the news that the manuscript of the fourth volume is ready. Prof. Dasgupta's remarkable exposition of Indian thought brings home to philosophers that the history of their subject is incompletely assessed and understood without a general knowledge at least of Eastern thought. The difficulty of perusing manuscripts in Sanskrit and other old tongues of the Dekkan Peninsula is minimized by the painstaking and judicious study carried out by Prof. Dasgupta, and the results of which are given in his great work.

The present volume deals more specifically with the religious philosophy of southern Indian schools, which are not orthodox for the most part with regard to official Brahmin thought. The Pañcavātras, for example, are considered of a lower caste and value by the orthodox Brahmins. This volume deals in turn with the Bhaskara school, the Pañcavātras and the Arvars, the Visistadvaita, Yamunacarya, the important Ramanuja school and the Nimbarka doctrines, and the Vijnana Bhiksu. The book ends with a detailed exposition of selected Puranas and the usual bibliographies and indexes.

The analysis of these teachings shows the alertness and depth of Indian thought at its best, whatever be their orthodoxy. Problems of knowledge, of religious psychology, of moral experience are well illustrated. The discussion of the nature of time according to Venkatanatha, to take one instance, is very illuminating, and exhibits the closeness of the Indian views with some Western doctrines. In fact, the comparative value of Indian philosophy is one of the characteristics that should induce European scholars to give more time and thought to it.

T. GREENWOOD.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. (1) System-Nummer 59: Eisen. Teil F II, Lieferung 2: Nachweis und Bestimmung von Fremdelementen in Eisen und Stahl. Pp. xvi+165+388. 27 gold marks. (2) System-Nummer 59: Eisen. Teil C, Lieferung 2: Prüfung der Kerbschlagzähigkeit. Pp. viii+288. 33 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1939.)

(1) After dealing in full detail with all the commoner analytical methods for the detection and estimation of titanium, aluminium, cerium, thorium, nickel and cobalt in iron and steel, the application of more modern methods is described in the part of "Gmelins Handbuch" under notice. Although no details are as yet available in the literature for the use of the chromatographic adsorption method of analysis, which has hitherto been used almost exclusively with organic compounds, its application by Schwab to the analysis of steels appears to be so promising that details of the process are given much more fully than might have been expected. Results which have been obtained with Heyróvský's polarographic method of using a dropping mercury cathode and a large mercury anode with gradually increasing voltage have shown that, after removal of the iron from the solution, an extremely sensitive and rapid method of qualitative and quantitative analysis of other elements is available. Photographic records can be obtained, but where speed is required they may be replaced by visible readings on a mirror-galvanometer scale. Perhaps the most sensitive method of all for qualitative analysis is that of spectrum analysis, which is fully described. Standard methods adopted by Australia, Canada, France, Italy, Japan, the U.S.S.R. and the United States are tabulated at the end. No standard methods have been adopted by Germany, and Great Britain is not mentioned.

(2) The extraordinary thoroughness with which the editors of "Gmelins Handbuch" are dealing with the metal iron is clearly shown by the issue of several highly specialized sections, of which this, which deals only with the notched-bar impact test for the toughness of iron and steels, is a sample. The chemist will find little of immediate interest, but the numerous drawings of machines, photographs of actual tests, graphs of physical properties and tables of reference to original papers should make it a valuable work of reference to engineers and metallurgists.

Chemische Physik der Metalle und Legierungen

Von Prof. Ulrich Dehlinger. (Physik und Chemie und ihre Anwendungen in Einzeldarstellungen, Band 3.) Pp. xi+174. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 12 gold marks.

Much exact experimental work has been carried out in recent years on metals and their alloys, and the knowledge of transformations of the crystal lattice, such as occur in plastic deformation, in the separation of a new phase, or in the change from a disordered to an ordered structure, has been greatly advanced. Progress has also been made in the description of the metallic state in terms of quantum mechanics. The stage has not yet been reached, however, at which the chief properties of a metal or alloy after a given treatment can be arrived at by deduction.

The work of Dehlinger, himself an active investigator in this field, aims at interpreting the relations between experiment and theory, especially for the benefit of the metallurgist. He treats of the thermodynamics of phase equilibria, with the distribution of electrons among the atoms, leading to the Hume-Rothery and similar rules, with the various types of structure among alloys, and with ferromagnetism. The last portion of the book deals with the kinetic aspects, such as diffusion, allotropic change, and precipitation of a new phase from solid solution. Plasticity and the mosaic structure of metallic crystals are only touched upon. Perhaps the most interesting sections are those which deal with the different forms of precipitation, including age-hardening. The book was probably completed too soon to include the important discoveries of Preston and Guinier on the nature of the initial stages of precipitation. Although German work receives most attention, an effort has evidently been made to cover the literature, and there is a useful bibliography.

C. H. D.

British Blood-Sucking Flies

By Dr. F. W. Edwards, H. Oldroyd and Dr. J. Smart. Pp. viii+156+45 plates. (London: British Museum (Natural History), 1939.) 15*s*.

The predecessor of this book entitled "Illustrations of British Blood-Sucking Flies" was written by the late E. E. Austen and published in 1906. Within a few years the edition was exhausted, and it evidently filled a definite need. Its successor is a larger and more informative work the aim of which is similar, and that is to provide information of interest to the non-specialist in the simplest possible manner. Increase in knowledge of blood-sucking flies since the 1906 volume has been great. Thus, in that year about 2700 species of British flies are stated to have been known, including 74 that are actually, or potentially, blood-suckers. In the intervening thirty-two years these figures have increased to 5,200 and 117 respectively. Much more important than mere additions of species is the notable increase in knowledge of their life-cycles and behaviour.

This volume deserves all praise: it gives the right kind of information required by the non-specialist and avoids irrelevant detail. The accounts of the species are supplemented by 45 excellent three-colour process plates. If a new edition of this work be called for, the practical aspect of the subject might receive more detailed consideration. A short section on the treatment of mosquito and other insect 'bites' by alleviatory measures or by repellents need not occupy much space but would be welcomed. We hope that the Trustees of the Museum will bear in mind the importance of issuing works, like the present one, of more general interest as well as those that only appeal to a small coterie of specialists and, sometimes, very few of them British subjects.

A. D. I.

FARMING WITHOUT SOIL

By Sir John Russell, F.R.S.,
Rothamsted Experimental Station

In the days before the War, which now seem to us so incredibly peaceful and remote, we were suddenly startled by Press announcements that an American professor had discovered how to farm without soil, and visions were evoked of intensive methods that would revolutionize crop production. One journalist went so far as to assert that all the wheat needed by Great Britain could, on this new method, be grown on an area the size of Euston Station.

When details became available the method proved to be the growth of plants in culture solutions, familiar to generations of botanical students under the name 'water cultures', and the fantastic claims had been arrived at by multiplying the area of the water culture vessel sufficiently to convert the square centimetres into acres. The claims must have been very embarrassing to Prof. Gericke, the originator of the method[1], and indeed the Department of Plant Physiology of the University of California with which he is associated took the unusual step of issuing a statement with the purpose of damping irresponsible enthusiasm and restoring some sense of perspective to what was actually an interesting application of botanical science.

It is unnecessary to remind botanists that perfect plant growth is possible in culture solutions provided the proper nutrients are given and certain conditions are maintained. The difficulty is to pass from the small scale of the laboratory to the large scale of the commercial market gardener and farmer, and only those who have had to make this transition know what it means. Prof. Gericke has shown how the large-scale grower can carry out water culture; he has worked out the conditions for a number of typical American crops, and indicated the difficulties likely to arise. Those with much experience of water cultures know the difficulties of getting really good results in the laboratory. The nutrient solution must contain not only the six or seven classical elements needed in relatively large quantities, but also those elements needed in small amounts only, especially iron, boron, manganese, copper; but as these trace elements are harmful in larger quantities it is necessary to use purified salts in research work. Due regard must also be paid to the changing requirements of the plant as it develops, arising from the circumstance that a given nutrient has different effects at different stages of the plant's life, while the reaction of the medium must also be controlled, as it tends to change during plant growth, and, if as often happens, it becomes alkaline, the iron is precipitated. The air supply to the roots is of vital importance, and steps must be taken to avoid the growth in the solution of algæ, bacteria and other micro-organisms which interfere with the proper course of the experiment. One looks to see how these difficulties are met, but apparently they cause less trouble on the large scale than in the laboratory. Prof. Gericke finds it necessary to have only one basic formula for all his crops, the salts need not be pure, no special precautions are taken about mixing them and neither aeration nor growth of micro-organisms in the solution caused trouble. Further, the solutions need not be changed frequently as in good laboratory practice; in some cases they even remained in use for a year. Distilled water, so essential in laboratory cultures, is obviously out of the question; tap or well water must be used instead, but so long as this is not heavily charged with salts it does not seem to affect the procedure.

The process is not, however, entirely simple. Iron may be thrown out of solution, or be present in inadequate amounts, and during the course of growth there may arise deficiencies of other elements. These could be detected by chemical analyses, but a simpler procedure is possible: the plant itself shows up the deficiencies by fairly characteristic symptoms which a good grower soon learns to recognize. These symptoms are described and illustrated, and this section gains in interest from the fact that the plants include some such as rice and cotton, which are not usually grown in laboratory exercises in Great Britain.

While recognizing the author's wide experience with water cultures, one cannot help wondering whether the absence of these and other difficulties may not in part be attributable to the clear and sunny skies of California, and whether large-scale experience would be equally fortunate in Great Britain, where conditions of temperature and light are often so different.

In a recently published book[2], details are given to help the grower. In laboratory practice the seeds are germinated in sand, sawdust, or moist blotting paper. On the large scale a seed bed is used, consisting of a tray of wire netting of one inch mesh and 19 or 20 gauge held on a frame 6–12 ft. long by 2–4 ft. wide, and containing moist litter—peat, fine wood shavings (wood wool), chaff, etc. After germination the seeds push their roots through the wire; the tray is then placed over the solution, and the roots dipping into it absorb the nutrients and proceed to elongate. In the laboratory water cultures are by long custom made in glass vessels—usually bottles—each containing one plant. On the large scale basins are used; so far it is not certain whether the best material is concrete, wood, sheet metal or such cheaper materials as troughs dug in the earth and lined with puddled clay. For all of them satisfactory results are claimed, especially after they have been in use, so that harmful substances have been dissolved out; in the case of metals, coating with asphalt enamel may be desirable. The whole problem of root aeration is avoided by the simple expedient of restricting the depth of the basin to six inches, and allowing sufficient space between the surface of the solution and the crown of the root to ensure movement of air. This depth also permits of evaporation and transpiration of about half the solution without detriment to plant growth. Greater depths required more of the chemicals and presented no corresponding advantage. Some of the basins described were up to 150 ft. long and 50 ft. wide.

The new method is complicated by the circumstance that each crop requires rather special treatment. Experience in ordinary cropping is no guide: two species, the author tells us, which behave similarly in soil might differ markedly in their reaction to water culture. There is also, he says, much less margin of safety in water culture than in soil; the solution "has a much lower resistance to chemical change than does the soil". Detailed instructions for a number of crops are given. The management of the seed bed is particularly important: it must be kept sufficiently but not excessively moist and the temperature conditions must be right. The crops must be closely watched for deficiency symptoms: lack of iron is made good by adding ferrous sulphate, lack of other elements apparently by adding more of the basic mixture.

Tomatoes are said to be among the best 'subjects', and some glowing descriptions are given of results obtained. In good glasshouse practice in England yields run about 6 lb. of fruit per plant: the author claims an average yield of 16 lb. and his highest yield was 27·4 lb. Potatoes in Great Britain average about 7 tons per acre, but a good grower will not uncommonly obtain 12 tons per acre: the author claims 48 tons per acre. Obviously if results of this order were generally obtainable the new method would revolutionize food production.

Incidentally, Prof. Gericke claims that the produce obtained by the new method is of high quality and of full nutritive value, thus ranging himself against those who regard humus as necessary for healthy crop production.

All those who have long been associated with agriculture are familiar with claims of new and vastly improved methods of production periodically put forward: after a short period of public interest they have practically all faded away: on the large scale they did not work. It still remains to be seen what will happen to this latest addition to the list. Three tests have already been made in Great Britain by competent and recognized authorities. From the Cheshunt Experimental Station[3], which specializes on crop-growing under glass, and has had very wide experience with tomatoes and cucumbers, it is reported that the new method yielded 3–4·7 lb. of tomatoes per plant according to the variety, this being lower than is obtained in ordinary soil culture, but 160 lb. of cucumber per plant, as against about 50 lb. in normal practice. Millard and Stoughton at Reading[4] obtained as good yields of tomatoes with the new method as with the old, and better results with gladioli; they could, however, find no evidence of the high yields claimed in California, and doubt whether English conditions of light and carbon dioxide supply would permit of them. Templeman and Watson[5] did not obtain as good yields as in soil. All these experiments go to show that in English conditions, at any rate, the method is not as promising as is claimed, though it may still have its uses for special purposes.

Among these may be town gardening. A Pelican Special has been issued giving in diary form Mrs. Hillyer's trials made for amateurs at her house in Hampstead, and therefore likely to appeal to townspeople who are interested in gardening and are fond of trying something new, but who lack garden space[6]. It is evident that she enjoyed the work, and her energy and enthusiasm enabled her to overcome many difficulties. In her view the new method provides a fascinating hobby, and indeed she thinks it offers "immensely more". The *Daily Mail* has given her space on the roof of its offices, and the services of its expert, Mr. Izzard. Here at least may be possibilities for development.

---

[1] NATURE, **141**, 536 (1938).

[2] The Complete Guide to Soilless Gardening. By W. F. Gericke. Pp. xvi+285. (London: Putnam and Co., Ltd., 1940.) 12*s*. 6*d*. net.

[3] Annual Report, 1939, p. 13.

[4] *Sci. Hort.*, 7, 174 (1939).

[5] *J. Min. Agric.*, 1938–39, **45**, 771 (1938–39).

[6] Hydroponics: Food without Soil; a Journal of Experiments, 1938 to 1940. By C. Isabel Hilyer. (Pelican Special S63). Pp. 116. (Harmondsworth, Middx., and New York: Penguin Books, Ltd., 1940.) 6*d*. net.

FUNDAMENTAL ASPECTS OF RADIO COMMUNICATION

A JOINT meeting of the Institute of Radio Engineers and the American Section of the International Scientific Radio Union was held at Washington, D.C., on April 26, 1940. Fifteen papers on the more fundamental aspects of radio communication were presented.

H. T. Stetson, of the Massachusetts Institute of Technology, Cambridge, Mass., reported on a comparison of field strength measurements with auroral occurrences and ionospheric disturbances during 1930–40. His results indicated that, beginning six days before the date of the aurora, field strengths of 770 kc./s. were abnormally high with a maximum intensity occurring on the average four days before the date of the occurrence of the aurora. From three days before until two days after the auroral occurrence field strengths decreased to a minimum and remained abnormally low until about six days after. For higher frequencies involving the F layers the auroral occurrences were compared with the transmission disturbance figures of the Bell Telephone Laboratories. Transmission disturbance was a minimum four days before the auroral occurrence, rose rapidly to a maximum one-half day following the dates of auroras, and then subsided to near the average value six days after the dates of the auroras. These results led to the conclusion that maximum transmission disturbance follows auroral phenomena and that the F layers are affected on the average about one day earlier than the E layer, based on more than three hundred days of observations utilized.

J. Bartels of the Carnegie Institution of Washington, N. H. Heck of the United States Coast and Geodetic Survey, and H. F. Johnston of the Carnegie Institution of Washington, all of Washington, D.C., described a new measure of geomagnetic activity, the three-hour-range index K. Each collaborating magnetic observatory assigns to each of the eight three-hour intervals of the Greenwich day one of the integers 0–9 as a range index K, by a method which effectively separates the two main solar influences on the ionosphere, namely, P (supposedly due to particles, and strongest in polar regions) and W (supposedly due to wave-radiation, restricted to the daylight hemisphere). It was described how P was measured by K, and a scheme for a geomagnetic record of W was sketched.

J. H. Dellinger and N. Smith of the National Bureau of Standards discussed the reliability of predictions of ionospheric characteristics and radio transmission. Starting more than a year ago, predicted values of critical frequencies and maximum usable frequencies were published monthly for the month following that of publication, in the *Proceedings of the Institute of Radio Engineers*. These published predictions were compared with the values afterwards measured. The results showed that the expected accuracy originally stated, 15 per cent, had been well met. The limit of accuracy is determined by the minor unpredictable variations of solar activity from its trend in the 11-year cycle.

L. V. Berkner and S. L. Seaton of the Carnegie Institution of Washington reported some phenomena in the F_2 region during geomagnetic disturbance. The ionospheric effects of ionosphere storms at an equatorial station were found to be similar to the well-known effects in temperate latitudes at night, but in the daytime the critical frequencies increased during a storm instead of decreasing, as they usually do in a temperate latitude.

In a paper by Messrs. Gilliland and Taylor, of the National Bureau of Standards, results were reported on ionosphere measurements during the eclipse of April 7, 1940. The recombination coefficient in the E layer was found to be approximately 10^{-8} and that in the F_2 layer less than 10^{-10}.

Olof E. H. Rydbeck of Harvard University showed that from a wave-mechanical interpretation of the propagation of electromagnetic waves in an ionized medium it was possible to calculate the true height of reflection from the virtual-height-frequency records. Thus the actual electron distribution could be obtained from experimental data.

K. A. MacKinnon of the Canadian Broadcasting Corporation, Montreal, Canada, reported some field intensity measurements of 540-kilocycle ground-wave propagation over the high-conductivity prairie provinces. The ground conductivities approached 10^{-12} electromagnetic units with a maximum near south central Saskatchewan. In certain directions the earth was electrically uniform to distances of about 400 miles.

I. E. Mouromtseff of the Westinghouse Electric and Manufacturing Co., Bloomfield, N.J., discussed forced-air versus water-cooling of large vacuum tubes. Mechanical and thermal limitations of air cooling devices were described. General rules for designing an air cooler were described.

Prof. E. L. Chaffee of Harvard University discussed space-charge relations in triodes and the characteristic surface of large vacuum tubes. It was shown theoretically and from experiments that the plate, grid, and total currents, in the absence of secondary emission, varied as the 3/2 power of the plate voltage along lines of constant $L=e_{go}/e_{po}$, where e_{go} and e_{po} were measured from a displaced origin. The three currents were then expressed in the form $i = Ae_p^{3/2}(1+\mu L)^{3/2}F(L)$. The entire system of static curves for each current can be expressed by a single curve. A simplification in the experimental determination of the static curves was suggested, permitting the static curves to be plotted from a few measurements at low power. The effects of secondary emission were discussed and curves were given which would aid in the design of tubes in which secondary emission from the plate was suppressed.

Prof. W. G. Cady of Wesleyan University, Middletown, Conn., reported a new method for the determination of the axes of quartz crystals by means of etch figures. A. de Gramont has shown that when a beam of light is passed through a quartz-crystal slab, one face of which has been etched with hydrofluoric acid, the rays are refracted in different directions, so that a lens placed close to the crystal projects on to a screen an image that is characteristic of the particular face that has been etched. If the etched surface is normal to the optic axis (Z-axis) the pattern takes the form of a three-pointed star, the points indicating the direction of the X-axis with a precision of about a degree. In repeating Gramont's experiment the author found that the pattern could be viewed directly through a powerful lens, for example, a $\frac{1}{4}$-in. microscope objective. The method furnished for the first time a simple and accurate optical method for finding the direction of the electric axis on a Z-cut slab of quartz.

Prof. Karl S. Van Dyke of Wesleyan University, Middletown, Conn., discussed the use of an etched sphere of quartz in identifying the orientation of quartz plates. He pointed out some discrepancies and contradictions in published papers, particularly as they related to the distinction between right and left quartz and the temperature coefficient of various 'cuts' of quartz resonators. This paper aimed at rectifying the discrepancies and contradictions which appeared in and caused confusion in the literature. Numerous papers involving discrepancies were specifically cited. All the factors concerned, etch figures, optical rotation, electrical polarization, and resonant frequencies, were in entire agreement with the elastic constants given by Voigt, and his equations for rotating the axes of reference, when used with his conventions as to axes and signs of angles. Taken together they made it possible to determine the peculiar and sometimes unstated conventions used by others in their published data.

C. R. Englund, A. B. Crawford, and W. W. Mumford of Bell Telephone Laboratories, Holmdel, N.J., discussed the diurnal variation of ultra-high-frequency optical-path transmission. Continuous records of ultra-high-frequency transmission on frequencies of 75 and 150 megacycles per second over a good 'optical' path showed variations in the received field. These variations were explained as being caused by wave interference, an interference which varied with the changes in the composition of the troposphere. The diurnal meteorological factors which affected the transmission were discussed.

Andrew Alford of Mackay Radio and Telegraph Co., New York, N.Y., and Sidney Pickles, International Telephone Development Co., New York, N.Y., described an ultra-high-frequency voltmeter of new design. This was made up of a current-indicating instrument associated with a closed quarter wave-length of line. The quarter wave-length of line was adjustable for a range of frequencies. The instrument was calibrated and held calibrations within the limits of engineering accuracy. Voltages instead of currents were then used with calculated surge impedances to measure transmitted power.

R. W. George of R.C.A. Communications, Inc., Riverhead, L.I., N.Y., reported on field intensity of motor-car ignition between 40 and 450 megacycles per second. The average field intensity varied about 2 to 1 over the frequency range. Vertical and horizontal polarization were compared and showed slightly greater field intensity for vertical polarization. New cars, old cars, and trucks showed no large differences of ignition field intensity.

Andrew Alford of Mackay Radio and Telegraph Co., New York, N.Y., discussed currents induced in wires by high-frequency electromagnetic fields. The experiments and theory showed that, except in special cases when resonance phenomena predominated, the induced currents were not even approximately sinusoidally distributed and that, therefore, theories based on the *a priori* assumed sinusoidal distributions were limited to wires of certain special resonant wave-lengths.

During the morning of April 27 an ionosphere conference of about forty persons was held at the Department of Terrestrial Magnetism, Carnegie Institution of Washington. The principal subjects discussed informally were: results of ionospheric observations during the solar eclipse of April 7, 1940; effects of magnetic storms on transmission conditions; methods for determining true heights of ionosphere layers; methods for predicting magnetic and ionospheric conditions; measures of radio transmission disturbance; the new range-index for measuring magnetic activity; present status of the Lorentz polarization correction.

OBITUARIES

Prof. E. W. W. Carlier

PROF. E. W. W. CARLIER died on September 2, 1940, in his seventy-ninth year at his home in Warwickshire. In him has passed away an outstanding personality.

Prof. Carlier was of French extraction, being the only son of Antoine Guillaume Carlier, officier d'Académie. He was born at Norwich in 1861, and received his early education at the King Edward VI School there. Later, he went to the Lycée de Valenciennes, where he graduated Baccalauréat ès Sciences. He began his medical education at the University of Edinburgh at the age of twenty-one, and took the degree M.B., C.M., with honours in 1886. After this, he was asked to join the junior staff in the Department of Physiology. He obtained the M.D. degree with first-class honours and gold medal in 1891. In 1895 he was appointed senior lecturer in physiology.

In 1899 he went to Birmingham as professor of physiology in Mason College, which in 1900 became the University of Birmingham. He held the professorship of physiology in the University of Birmingham until his retirement in 1927, when he was elected emeritus professor.

During 1909–14, Prof. Carlier was examiner in physiology for the first fellowship examination of the Royal College of Surgeons. He was vice-president of the Physiological Section of the British Medical Association at Ipswich in 1900, and at Birmingham in 1911. He was a member of the Royal Society of Edinburgh, and of the Royal Entomological Society. For seven years he was honorary secretary of the Scottish Microscopical Society and vice-president for one year.

In 1895 he married Hannah Culver of Hughenden, who died in 1929. He leaves a daughter and two sons.

When he was at the University of Birmingham Prof. Carlier was instrumental in the building and equipment of a new histological laboratory, which was admirably adapted to its purpose. He conducted the classes in histology himself; his descriptions of the slides were a marvel of lucidity; he saw to it that first-rate material was supplied, and many of his own magnificent preparations were distributed to the students, whose work he superintended individually. At each session students were privileged to examine slides from his unique private collection, which is of European reputation, and which, at the request of the British Museum, is now being sent there.

Prof. Carlier carried out a large amount of research work, many of his papers being published in Germany and France. Perhaps his greatest contribution to physiology was the combination he made of experimental and histological methods as exemplified in his discovery of the functions of the nucleolus in cellular fatigue, his work concerning the changes observable in the gastric secreting cells during digestion, and the secretion of ferments by the liver cells.

Besides physiology, Prof. Carlier took a keen interest in other branches of science, particularly natural history; he was seven times president of the Birmingham Natural History and Philosophical Society. He made a special study of entomology, and since his retirement was engaged in research on the Lepidoptera. He had a very fine collection of butterflies. He was an enthusiastic gardener, and his class was often cheered by the sight of some special flower in his buttonhole or on his table. At the age of seventy he began a research on the Rotatoria, Rhizopoda, and Heliozoa, for staining which he invented a laborious, but very effective process.

Prof. Carlier had a tall and imposing appearance, and students at first were apt to be intimidated by his somewhat abrupt manner and penetrating look, but they soon discovered his genial kindliness, readiness to help in any difficulty, and genuine liking for young people. Women owe him a debt of gratitude in that he upheld their claim to a medical education when this met with much opposition.

Prof. Carlier was deservedly popular, and was held in affectionate esteem by his colleagues, laboratory assistants and students. He will be missed by a large number of friends. HILDA WALKER.

Dr. W. E. Harper

DR. WILLIAM EDMUND HARPER, who died on June 14, at the age of sixty-two, had been director of the Dominion Astrophysical Observatory since 1936. Dr. Harper was born in Ontario on March 20, 1878, and graduated from the University of Toronto in 1906. On that day he received word of his appointment to the staff of the Dominion Observatory at Ottawa. For thirteen years he was engaged there in the determination of the orbits of spectroscopic binaries, and on his transfer to Victoria, when the Government sponsored the 72-inch reflector, he continued the same work. In 1924 he was made assistant director, and finally director in 1936. From the time of his graduation until his death he was intimately associated with the development of astronomy in Canada. Before his death he had determined the orbits for more than a hundred binaries. No other astronomer has approached this number. His contributions to this part of astronomy constitute approximately one quarter of the known orbits. Among other major pieces of work were the determination of 1,100 spectroscopic parallaxes and the measurement of over 7,000 plates for radial velocity.

Dr. Harper took a very active part in popularizing astronomy in Canada. He was a member of the Royal Astronomical Society of Canada and served on the executives at Ottawa and Victoria and was president of that national society for the years 1928–29. He also sponsored a series of popular astronomical articles for the Press, and the revenue from these articles was devoted to a trust fund for the encouragement of amateur astronomy under the auspices of the Society. For many years he gave monthly radio talks on astronomical topics which did much to stimulate interest in the subject throughout the Dominion and even farther afield.

Dr. Harper's services to astronomy were well recognized throughout the astronomical world. In 1913 he was made a fellow of the Royal Astronomical Society of Canada. In 1924 he was elected to the Royal Society of Canada, and in 1935 the University of Toronto, on the occasion of the dedication of the David Dunlap Observatory, conferred on him the degree of doctor of science. In 1938 he was appointed as official Canadian delegate to the General Assembly of the International Astronomical Union at Stockholm. It was while absent on this trip that he was taken seriously ill with pneumonia. For several weeks he lay critically ill in Rostock Hospital and the international crisis finally necessitated his removal by ambulance to Denmark and thence to England. He returned to Canada in October somewhat improved and attempted to carry on, but suffered a serious relapse the following spring which a year later proved fatal. In his death, Canada has lost a very worthy citizen and a distinguished man of science.

R. K. Young.

Mr. R. M. Wilson

The sudden death on September 15 of Mr. Robert Melville Wilson, principal of the South-Eastern Agricultural College at Wye, has removed a notable figure from the British agricultural educational world.

Mr. Wilson was fifty-four years of age. He graduated at the University of Edinburgh and gained the national diploma in dairying. He obtained a Carnegie scholarship for research in mycology at the Heriot Watt College, Edinburgh, and in 1910 became a lecturer in agriculture for East Lothian and Peebleshire. In 1911 he became lecturer in agriculture and dairy farming at the East Anglian Institute of Agriculture, Chelmsford, where he performed splendid work in enhancing the reputation of the Winter School and Dairy School. In 1914, after holding an inspectorship in the Education Branch of the (then) Board of Agriculture, Mr. Wilson returned to the East Anglian Institute as principal and agricultural organizer for Essex. Several administrative appointments were held concurrently with the principalship at Chelmsford, and in 1920 Mr. Wilson was elected a member of the Council of Agriculture for England.

In October 1922 on the resignation of Principal M. J. R. Dunstan, Mr. Wilson was appointed to the principalship of the South-Eastern Agricultural College at Wye. From the day of his arrival Mr. Wilson continued to build the reputation of the College both as an educational and research centre. His constant interest in every aspect of the College's many activities was evinced by the enthusiasm with which he described to others the work that the various members of his staff were doing. He was always ready to devote time and energy to solving the difficulties of research workers, teachers and students alike, and was never too busy to discuss with any member of the College the problems or interests of his particular branch of study or research, and to bring the keenness and enthusiasm of his own nature to bear with vitalizing encouragement upon the question at issue. At all times Mr. Wilson was an idealist, he expected the best and believed the best of everybody. He was a great believer in the educational value of the pursuit of the solution of original problems in horticulture and agriculture and he encouraged students to take this view in their work. He kept in close contact with old students and was enthusiastic about their successes and ever ready to help them to progress in their careers.

At the outbreak of War Mr. Wilson threw himself into the task of training members of the Women's Land Army, and the kindly and understanding way in which he carried this out was much appreciated. It was a great satisfaction to him to re-open the College in January for the ordinary courses and a corresponding disappointment when it was found impossible to continue this autumn. He felt deeply the break with students and with members of his various staffs who were taking up new work, and no doubt this told heavily upon him. One who never spared himself, he was loved and respected by all who knew him, and heartfelt sympathy goes out to Mrs. Wilson and members of the family in their bereavement.

We regret to announce the following deaths:

Prof. Max Cloetta, formerly director of the Pharmacological Institute, University of Zurich, aged seventy-two.

Mr. E. P. Van Duzee, curator of the Department of Entomology, California Academy of Sciences, on June 2, aged seventy-nine.

Prof. J. Goldschmidt, formerly director of the Berlin Institute of Criminology, aged sixty-six.

Sir Robert Hadfield, Bart., F.R.S., metallurgist and industrialist, on September 30, aged eighty-one.

Mr. F. C. Hart, manager of the Optical Lantern Department of Messrs. Newton and Co., Ltd., scientific instrument makers, on September 4, aged sixty-three.

Mr. F. H. Hooper, formerly editor of the "Encyclopædia Britannica", manager during the War of 1914–18 of the New York office of the Ministry of Food, on August 16, aged seventy-eight.

Mr. Cherry Kearton, the pioneer in popular natural history photography, on September 27, aged sixty-nine.

Colonel J. J. M. Shaw, consulting surgeon to the Army of the Middle East, a member of the National Radium Commission, aged fifty-four.

NEWS AND VIEWS

A Standard of Protection against Incendiary Bombs

In response to a demand for materials and treatments of comparatively low cost which would afford a useful degree of protection against incendiary bombs, though not necessarily as high as that required of the incombustible material conforming to specification BS/ARP No. 27, the British Standards Institution has issued a new specification designated BS/ARP No. 47. This deals with the testing of incombustible material providing a minimum standard of protection against incendiary bombs. The specification fixes a standard of protection such that materials conforming therewith will (*a*) markedly reduce the lateral spread of fire on protected surfaces ; (*b*) markedly retard or even prevent entirely the outbreak of a destructive fire ; and (*c*) markedly reduce the damage to protected timber floors, usually confining it to the slow burning and charring of a square foot or so of boarding. It is emphasized that the adoption of protection to the standard fixed by the specification does not obviate the necessity for active defence against bombs by the stirrup hand-pump or other fire-fighting appliance. By retarding the effects of the bomb, the time during which it or the resultant fire may be effectively dealt with is appreciably increased. Copies of the specification are obtainable from the Publications Department of the British Standards Institution, 28 Victoria Street, London, S.W.1.

Empire Drug Cultivation

The memorandum on medicinal herb production recently issued by the Ministry of Health (Nature, Sept. 21, p. 397) confined its observations to the four important drugs, belladonna, digitalis, hyoscyamus and stramonium. It is not surprising that other authorities have taken up the matter at the point where the Ministry left off. An official body representative of the medical profession has recommended that in addition to the four drugs which the Ministry of Health has taken under its care, the production of the following items of vegetable materia medica should be encouraged in Great Britain: anethum, caraway, chondrus (Irish moss), colchicum, Filix-mas, valerian, hamamelis, taraxacum, pyrethrum, psyllium, Datura tatula, fennel and liquorice ; that the collection of seaweeds, as a source of iodine, should be undertaken on a large scale. The same official body also recommends that the production of the following drugs should be pursued within the British Empire: agar, bitter orange peel, benzoin, balsam of tolu, calumba, camphor (natural and synthetic), cantharides, mirabilis, cascara sagrada, cinchona, chrysarobin, cocaine, creosote, derris, ephedrine (natural and synthetic), ergot, gentian, liquorice, hamamelis, Hyoscyamus muticus, ipecacuanha, jaborandi, krameria, lobelia, menthol (natural and synthetic), almond oil, star aniseed oil, oil of cade, oil of chenopodium, oil of lemon, oil of peppermint, turpentine and colophony, psyllium seeds, rhubarb (*Rheum raponticum*), santonin, squill, storax, thymol (natural and synthetic) and tragacanth.

Mycenæan Origins and Chronology

The beehive tomb or *tholos* at Mycenæ known as the "Treasury of Atreus" is one of the most important monuments of the Bronze Age in Greece, and the finest example extant of Mycenæan architecture. Its significance in the reconstruction of the course of development of the early civilization of the eastern Mediterranean was further emphasized when Sir Arthur Evans, on the evidence of a beehive tomb then recently discovered in Crete, attributed the Treasury of Atreus to a Minoan derivation, assigning it to an earlier date than that generally accepted and making it the archetype of which other and inferior beehive structures at Mycenæ were degenerating derivatives. This conclusion ran counter in particular to the results of excavations in the dromos, the walled passage approach to the Treasury, carried out by the British School of Archæology at Athens in 1920–23. On general grounds and in view of their numerical distribution, the beehive tombs might well be, it seemed, a product of the Mainland or Mycenæan civilization, while the excavations pointed to a date not later than 1350 B.C. This date harmonized with a logical and natural evolution in architectural development which emerged from study of the three groups of beehive tombs.

With the view of meeting objections to this view raised by Sir Arthur Evans and Prof. J. L. Myres, based in the main upon a hypothetical reconstruction of the dromos, a further examination of the dromos was undertaken in 1939, of which the results have been reviewed by Mr. A. B. Wace in *Antiquity* of September. They would go to show conclusively that the Treasury of Atreus is to be assigned in date not to the close of the Middle Minoan period in the late seventeenth century B.C., the great building period at Knossos, as Sir Arthur Evans argues, but to a date not before 1350 B.C. The evidence is derived from household refuse in a cleft which was cut through by the builders, and in which the pottery fragments and other relics are shown to range in date from 1450 to 1350 B.C. This refuse is of further interest in that it is derived from a group of houses belonging to a well-to-do residential quarter, standing on the ridge above the Treasury. This residential quarter is the first of its kind so far found at Mycenæ outside the citadel walls.

Archæology and Tradition

How far it is justifiable or even permissible to make use of tradition or 'folk-memory' in the interpretation of archæological data and the results of archæological excavation has been the subject of much argument. Some, like Lord Raglan, regard it as almost or completely valueless, while others would concede that in the reconstruction of prehistory, legend and folk-lore may sometimes afford a valuable clue to cultural or racial impact and subsequent changes in style, technique and practice. The question is one of no little importance in the pre- and early history of the British islands, where the traditions and lore of the Celtic-speaking peoples should be a mine of information as yet far from fully explored from this aspect. It is not often, however, that it is possible to bring a tradition to the bar of judgment and decide upon its value so conclusively as have Dr. F. J. North and Mr. W. F. Grimes in "The Legend of Llys Helig—its Origin and Significance" (Supplement to the Proceedings, Llandudno, Colwyn Bay and District Field Club, Llandudno, 1940. Pp. x+67, with 8 pls. Price 5*s*.).

Helig, the story goes, was a king of North Wales who flourished towards the end of the sixth century of our era, though the statements as to his lineage, etc., allow a margin of variation of some centuries in dating. At this period, it is said, an inundation overwhelmed his lands and a considerable portion was irretrievably lost. Llys Helig is the name given to a patch of seaweed-covered stones to be seen when the tide is at its lowest out to sea off Penmaenmawr. It is popularly regarded as the site of Helig's palace; and in 1864 an account of an expedition to view the 'sunken ruins' by Mr. Charlton Hall described them as "a grand old hall of magnificent dimensions". The authors of the present account have made an exhaustive analysis of the literary, historical, geographical, geological and archæological evidence, which points to the conclusion that much of what has been adduced as evidence is inadmissible; and that such valid evidence as there is demonstrates conclusively that the spot where the stones occur could not have been occupied by human beings at any period to which the legend is supposed to relate; while the final verdict of geologist and archæologist is that Llys Helig itself is a heterogeneous and unsorted assemblage of boulders representing the debris of a denuded hillock of boulder clay, and never has been the component part of any building or structure, even such as a weir.

Seals in the Ancient East

Seals and sealings are so frequently the subject of reference and their importance so often stressed in accounts of archæological investigations in the ancient East which are directed to the interest of a public comprising others than the expert, that any attempt to extend a knowledge of the historical and cultural importance of the subject as well as of the intrinsic merits of the seals themselves is deserving of every encouragement. Dr. Henri Frankfort's excellent work, though by no means heavy reading, is probably too detailed for all but those who have made some headway in the subject. For those whose interest whether in the historical value or the æsthetic merits of the ancient seal has still to be aroused, a recent leaflet of the Field Museum of Natural History, Chicago ("Ancient Seals of the Near East" by Richard A. Martin. Leaflet 34, 1940. Pp. 4, with 24 illustrations and explanatory text. 25 cents) is an excellent provocative.

Twenty-two sealings are illustrated from reproductions in the frieze of the Babylonian Hall of the Museum. They cover some of the finest examples in the major periods in Near Eastern glyptic art from the fourth millennium B.C. (Jemdet Nasr) to the third-fourth century A.D. (Sassanid), when the pictorial stamp seal of the Near East was drawing near its end. Among the more notable examples included are seals of the Agade period when the art reached its highest expression, the Ur-Nammu seal of the twenty-third century B.C. with its remarkably fine type of Babylonian writing, the highly ornamental Hittite seal of the fourteenth century B.C. in which four Gilgamesh figures in a wheel recall the early origin of the swastika, and last but not least for its historical significance the Harappa seal, showing elephant, rhinoceros and crocodile, found in Mesopotamia but unquestionably imported from the Indus Valley. The explanatory text which accompanies each illustration gives such historical and mythological detail as is adequate for understanding of the subject-matter of each seal impression. Technically the illustrations are almost beyond criticism.

Mound Builders' Temple, Ohio.

Exploration of a mound near North Benton, Ohio, has brought to light the remains of a structure identified as a temple in which a number of objects are apparently new to knowledge of the culture of the Mound Builders. The mound was excavated by Mr. Roy Saltman and Mr. Willis H. Magrath. It has been assigned by Mr. Richard I. Morgan, curator of archæology in the Ohio State University, to the Hopewellian phase, the most advanced of the Mound Builder culture, which extended from Ohio down the Mississippi and Tennessee valleys. In an account of the excavation (*Scientific American*, August 1940), it is stated that within a circle of stone slabs there was evidence of an inner wall of wood in the form of charred stumps, which had supported a circular building nearly 70 ft. in diameter. A corridor from a gateway in the west side led to a fireplace in the middle of the temple floor. Stone altars and clay cones flanking the corridor bore charred bones and offerings of stone implements, mica, galena and copper.

The most striking feature of the temple was the figure of an eagle of white sandstone flags on an understructure of moulded clay, which measured 32 ft. across and 16 ft. from head to tail. It was headed towards the rising sun. Overlying the wings were two human skeletons, male and female. Numerous broken fragments of human skull bones and similar fragments on the nearby altar stone suggest human sacrifice as part of a burial ceremonial. Not only is the eagle figure unique, but also human sacrifice is a new element in finds in other branches of the Hopewellian culture. The culture of the Mound Builders, which developed between the beginning of the Christian era and Columbian times, had disappeared before the arrival of Europeans. The suggested connexion between this culture and that of Mexico and Central America might well account for the appearance of human sacrifice, to which the inhabitants of Mexico were particularly addicted.

Murder by Children and Adolescents

IN his inaugural thesis (*Thèse de Paris*, No. 108; 1940), Dr. Louis Begon, who records seven cases of attempted murder committed by males aged fourteen to nineteen, states that the motives for murder at this age show a much greater variety and are much more complicated than in the case of adults. The medico-psychological examination of cases of murder by young persons is of considerable practical interest both as regards the outlook of the case and the prognosis. The offenders may be classified in three different groups. The first consists of those guilty of a single offence. In such cases the prognosis is good, and a relapse is not likely to occur, provided that a change is made in the environment, which has an important influence on the determination of the act. The second group consists of those in whom murder is the result of disease. In such cases internment is required. The third group is formed by abnormal persons who are not really insane or suitable for detention in an asylum, but are dangerous individuals against whom society should be protected, in the absence of which protection a recurrence will probably happen.

Tuberculosis in Mental Hospitals

IN a paper (*Amer. J. Psychiat.*, 96, 1335; 1940) based on his experience of pulmonary tuberculosis in mental hospitals during the last nine years, Dr. C. A. Wicks states that though the tuberculosis mortality rate for patients in the Ontario mental hospitals has shown a tendency to decrease since 1934, in 1936 the rate was fourteen times greater than that for the province as a whole. Approximately 2·5 per cent of 2,908 patients admitted to the Ontario mental hospitals during 1938 required isolation on account of X-ray findings in the chest. From the tuberculosis situation as it existed in January 1939 it was estimated that a central tuberculosis mental hospital would be required to accommodate approximately 5·2 per cent of the patients in Ontario mental hospitals. X-ray examination of the chest in 2,542 staff in the Ontario mental hospitals in 1937–38 showed that 0·6 per cent required treatment for tuberculosis. Since 1933, about 0·5 per cent of the employees have needed such treatment every year. About 1·7 per cent of 839 apparently healthy applicants or new staff in the Ontario mental hospital service during the calendar year 1938 showed X-ray evidence of pulmonary tuberculosis which was active or possibly active, thereby rendering them unacceptable for employment.

Public Health and Advertising

IN a paper read before the Health Officers' Section of the American Public Health Association (*Amer. J. Public Health*, 30, 880; 1940) Dr. K. E. Miller, medical director, U.S. Public Health Service, remarks that unrestrained advertising becomes a matter of public health concern primarily in connexion with those products which either directly or indirectly affect public health, such as foods, drugs and cosmetics. He points out that one of the most potent means for regulating unfair practices and protecting public health interests consists in the control of false and misleading advertisements, especially of those products which may be injurious to health. Apart from changes in the existing laws, State and local health forces can make valuable contributions to the success of the campaign against dangerous nostrums and the advertising of other medicinal products.

Fatal Accidents in the United States

ACCORDING to the *Journal of the American Medical Association* of August 10, p. 470, the United States Bureau of the Census recently published a statistical study of fatal accidents in the six years 1933–1938. In 1933, fatalities from accidents totalled 90,932, and thereafter the number rose to a maximum of 110,052 in 1936. Then it decreased to 93,805 in 1938. Deaths caused by fires, which ranked seventh among all accidental causes during 1933–37, advanced to the sixth place in 1938. Figures for the successive years were 1,521 in 1933, 1,752 in 1934, 1,581 in 1935, 1,913 in 1936, 1,688 in 1937 and 1,650 in 1938. There were more victims from fire in the age group 5–9 than in any other group in 1938; there were 129 deaths in this group, which was 7·8 per cent of all persons burnt to death. The next largest number was in the group 50–54 with 109 deaths. Only 18·3 per cent of deaths from injury by fall occurred among persons less than forty-five years of age, who form 77 per cent of the population, but 55·8 per cent of the motor fatalities and 91·3 per cent of aeroplane fatalities were in this younger group.

Improvement of Grassland

GRASSLAND improvement is the main theme of the July number of the *Scottish Journal of Agriculture* (23, No. 1, H.M. Stationery Office. 1*s*., postage extra). Viewing the subject as a whole, a moderately long-term policy for higher farming is advocated, since facilities for improvement are now specially favourable, and stock-carrying capacity must be increased and fertility built up for the future. As a means of maintaining hill grazing as an economic proposition, the introduction of cattle, or a considerable increase in their numbers, is suggested. Bracken control is also dealt with in some detail, and the various machines recently used for this purpose described. With regard to the renovation of old pasture, practical experience has shown that ploughing is preferable to surface harrowing, and that seed-bed consolidation is essential for success. The suitability of mixtures for re-seeding, and the chemical aspect of grassland improvement are also considered. An article on ensilage and grass drying completes the other side of the picture, the different methods of conserving grass and their relative feeding values being fully described and discussed. Among other subjects of current interest in this number of the *Journal* is a well-illustrated account of a new method of trapping and destroying rabbits on a large scale. The *Journal* is now to be issued half-yearly instead of quarterly.

Vocational Training and Black Rust Control

THE classical struggle of the United States Department of Agriculture against the black rust disease (*Puccinia graminis*) of small grains, forms the subject of a leaflet (No. 1, Revised 1939) entitled "Teaching the Control of Black Stem Rust of Small Grains in Vocational Agriculture Classes". This has been prepared by the Vocational Division of the Office of Education, U.S. Department of the Interior. Destruction of common barberry, the alternative host plant of the fungus, still requires to be practised, and a teaching plan for the portrayal of this need is detailed in the leaflet. The life-history of the fungus and its devastating effects are shown by effective diagrams and small photographs, and even the most unimaginative teacher could scarcely fail to thrill a class if he followed the suggestions put forward. Co-operation with the U.S. Department of Agriculture has been closely maintained, with the result that a valuable source of specialist information is provided for the general teacher.

Animal Husbandry in India

THE report has just been published of the *Proceedings* of the third meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India (Simla: Gov. India Press, 1940). The meeting was held at New Delhi during February 20–23, 1939, and the variety of the nineteen topics discussed indicates the complexity of India's problems and the research activities which have been stimulated through the influence of the Imperial Council of Agricultural Research. Reference to the *Proceedings* and the discussions recorded there show how valuable to the investigators and agriculturists concerned must be the pooling of information from all the corners of the land which takes place at such meetings and helps to determine the lines upon which particular investigations must be conducted. But we must add that the form in which the *Proceedings* are published leaves much to be desired: there is no index to the subjects or authors mentioned in these 307 pages, and even the list of topics has no page references to guide the inquirer; so that, for example, we find the discussion on the warble-fly on p. 88, and the introductory remarks on which the discussion was based on p. 155, with a title which, as printed, is unintelligible.

Pictorial Illustration for Engineering Draughtsmen

IN the drawing office a rigidly conventional system of orthographic projection is employed which tends towards the suppression of ability in pictorial representation. To the draughtsman himself his conventional views are sufficiently expressive and communicative, but occasions arise when greater realism is necessary in order to inform and impress the uninitiated. For guidance in this unaccustomed field, the Association of Engineering and Shipbuilding Draughtsmen has issued a new publication entitled "Freehand Drawing and Pictorial Illustration for Draughtsmen" by W. H. Kerry and E. W. Stott (London: The Draughtsman Publishing Co., Ltd. 2*s*.) which shows how in a number of typical cases pictorial sketches can be prepared. A chapter devoted to "Perspective Construction", on which the subsequent treatment is based, is followed by a statement of the nature and classes of work which the engineering draughtsman may be called upon to treat pictorially, and the purposes for which this method of treatment is necessary; as, for example, the illustrations required by the Patent Office. The main subjects are dealt with under the titles "Treatment of Machine Details", "Conventional Treatment" and "Illustration for Reproduction with an Outline of some of the Printing Processes", and the whole forms a sequence of practical instruction which must prove invaluable to the draughtsman who is unskilled in this unfamiliar field and uninformed regarding the methods to use for different conditions of reproduction.

Properties and Applications of Witherite

IN *Engineering* of September 13 there is an interesting article on the properties and applications of witherite (barium carbonate). It is stated in a handbook issued jointly by the Holmside and South Moor Collieries, Ltd., and the South Moor Collieries, and the Settlingstones Mines, Ltd., that witherite is found in economic quantities only in the northern part of England and that the mines producing it supply the world demands for the mineral. The material derives its name from that of Dr. W. Withering, a Birmingham physician and amateur geologist, who in 1784 when examining samples taken from an old lead mine at Alston Moor, on the borders of Cumberland and Northumberland, first recognized the mineral to be chemically distinct from barytes.

Large quantities of witherite are used annually in the preparation of precipitated barium sulphate (permanent white) which is employed in the paper industry for the manufacture of highly glazed coated papers. It is also used in the printing ink and colour industries, in the manufacture of paints and as a filler in the rubber, linoleum and other industries. Among other engineering applications of witherite is the softening of water for boiler feed. It is specially useful when scale-forming and corrosive waters are encountered. Thus sodium and calcium sulphates are converted into the carbonates of these metals, with the precipitation of insoluble barium sulphate. Ground witherite mixed with wood charcoal, usually in the proportion of 40 per cent of the former and 80 per cent of the latter, has been used for many years as an energizer for carburizing compounds in the case-hardening industry. Considerable proportions of barium oxide, in some cases nearly 50 per cent by weight, enter into the composition of crown and flint optical glasses used for the production of lenses. Finely divided barium carbonate is also claimed to increase the resistance of cement to the action of sulphate-containing waters.

Credit and the Family Budget

The Office of Education, United States Department of the Interior, has issued a bulletin "Credit Problems of Families" (Vocational Division Bulletin No. 206, Home Economic Series No. 23) to aid teachers of home economics in guiding students in an understanding of the place of credit in family financial management and in the solution of their own credit problems. Credit has played an increasing part in recent years in the financial plans of American families, and this study, which covers both credit for everyday use and long-term uses of credit, is intended to assist the understanding of the principles governing the sound use of credit. Numerous suggestions to teachers are included.

Help for Scientific Research in Canada

The Canadian Government has announced the appointment of nine members to administer funds presented by patriotic citizens for assisting technical projects and scientific investigations now being undertaken or proposed by the National Research Council with the object of increasing the efficiency of the Canadian war effort. The chairman is Dean C. J. Mackenzie (acting president of the National Research Council), and the members include Sir Frederick Banting, Mr. J. S. Duncan (Deputy Minister for Air), Prof. Maas (head of the Physics Department of McGill University), and Colonel Allen Magee (executive assistant to the Minister of National Defence). Funds given or promised amount to £225,000.

The *Sedov* on a New Expedition

The Geographical Department of the Northern Sea Route Administration (U.S.S.R.) has sent out the icebreaker *Sedov* on a new expedition to the north-eastern part of the Kara Sea. It will be remembered that the *Sedov* returned to Murmansk on January 29, 1940, after a remarkable drift in the Arctic of twenty-seven months duration. The head of the new expedition is Mr. V. I. Vorobyev. The purpose of the expedition is to study one of the most important parts of the Northern Sea Route in the Kara Sea—from Izvestia Tsik Islands to Russky Island. The total length of this part is about two hundred nautical miles. The expedition is to carry out hydrographic and hydrological research: it will make systematic soundings of the depths of the sea, study the currents, wind regime, ice conditions, and carry out magnetic observations.

Announcements

Dr. K. E. Bullen, lecturer in mathematics at University College, Auckland, New Zealand, known for his work in seismology, has taken up an appointment in the Department of Mathematics of the University of Melbourne.

Sir Arthur Hurst will deliver the eighteenth Norman Kerr Lecture to the Society for the Study of Inebriety on October 8 at 4 p.m. in the Friends House, Euston Road. His subject will be "Alcohol and the Organs of Digestion".

In consequence of the War, it has been decided to postpone, for the present, the Chadwick Public Lectures which were to have been delivered this autumn.

The following are serving as officers of the Society of Chemical Industry for 1940–41: *President*, Prof. J. C. Philip; *Honorary Treasurer*, Dr. L. H. Lampitt; *Honorary Foreign (or Overseas) Secretary*, Dr. Wm. Cullen; *Chairman, Bureau of Chemical Abstracts*, Dr. L. H. Lampitt; *General Secretary*, H. J. Pooley, Clifton House, Euston Road, London, N.W.1.

The average mortality rate from all causes in the large cities of the United States for the four weeks ended June 15, based on data received from the Bureau of the Census, was 10·9 per thousand inhabitants. The average rate for this period in the five preceding years was 11·0.

The Medical Research Council has received four motor-vehicles specially equipped for medical work from the United States. These were originally purchased by the American Quakers and the International Commission for the Assistance of Child Refugees for use in France. The vehicles now are to be used principally in the work of the Emergency Blood Supply depots in the neighbourhood of London.

Dr. F. Hoyle, St. John's College, Cambridge, writes: "I have noticed an error in a letter by Lyttleton and myself on 'The Evolution of the Stars' appearing in Nature of July 20, p. 97. The sentence 'Thus the effect of collisions is to excite the vibrational and rotational levels of the $^3\Sigma$ state of the molecules, and this internal energy can be radiated by quadrupole transitions to the ground state of the molecules', should read: 'Thus the effect of collisions is to excite the vibrational and rotational levels of the $1^1\Sigma$ state of the molecules, and this energy can be radiated by quadrupole transitions as an infra-red spectrum'."

Erratum. In the obituary of Prof. A. E. H. Love in Nature of September 21, p. 393, three lines from foot of second column, for "Anthony Berry" read "Arthur Berry".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Origins of Electric Transmission by Resonance

The death of Sir Oliver Lodge, full of years and honour, recalls brief episodes in the early development of wireless telegraphy. One remembers Lodge describing how he and his assistant at Liverpool were experimenting with a Hertzian spark vibrator: another such vibrator, a duplicate of it, happened to be at the distant end of a long lecture bench, and they noticed an extraordinary development of receptive sparking in it. With the simplicity of genius Lodge recognized that this was due to resonance, for the period of vibration in the receiver must be the same as that of the identical transmitter. One result was a master patent, which was for long a thorn in the side of practical adventurers. (The Bell telephone happens to be another instance of reciprocity of emitter and receiver.)

One may ask, did Hertz in his classical experiments on wave-lengths take this very striking role of Fourier resonance into his chain of ideas ? (FitzGerald had remarked on it five years earlier.) His broken ring receiver would probably have had to be inconveniently large to bring it into resonant relation. One seems to remember that it gradually occurred to informed minds that the vagaries of reception were due to the disturbance selected by the receiver being largely a Fourier component of its own wave-length, as that one was intensified by resonance, so that the wave-length observed would be that of the receiver, not the emitter; a principle now of utility in the other direction to prevent sympathetic leakage into adjacent systems.

During a lecture by Lodge at the Royal Institution, a vibrator on the table was observed to excite sparks on the gold-patterned paper on the walls: but these were perhaps more likely ordinary electrodynamic effects due to completion across a gap of metallic circuits. The converse case was D. E. Hughes's much earlier uninstructed detection of electric waves at the appropriate much greater distance, from which he was dissuaded by the conservative frame of mind of Stokes, strikingly effective also on the mentality of his disciple Lord Kelvin, though he was himself the detector of fluorescence.

In the well-known contemporary account of Hertz's discovery by G. F. FitzGerald of Trinity College, Dublin, which now happens to be accessible here in his Collected Papers, I find, however, some reference to tuning of the receiver. One remembers, by the way, the excitement then produced in Dublin by the direct reception of the news of a regatta in the Bay from Marconi who was a guest on the flagship. FitzGerald was a close friend and indeed instructor of Lodge, who after his premature death became a life-long apostle. The wave properties of electric transmission on analogy with those of light were closely pursued in his few later years in FitzGerald's laboratory, which then included the present Provost of that illustrious College.

These considerations are largely out of date in practice, but though simple they are far from obsolete in theory, which should avoid abstruseness.

Joseph Larmor.

Holywood,
N. Ireland.
August 23.

Structure of Liquid Argon

Most of the X-ray investigations of liquids have led to a distribution function which cannot be compared directly to the corresponding distribution of atoms in the solid since one peak in the liquid distribution function usually corresponds to several peaks in the distribution function of the solid. For this reason we investigated several years ago the structure of molten salts such as potassium chloride and lithium chloride where one can assign to each peak in the liquid distribution function one peak in the distribution function of the solid. We have shown that the co-ordination in the liquid and the solid is the same; number of first neighbours N_1 in the solid equals 6 and in the liquid 5·8. The number of second neighbours N_2 in the liquid (K–K or Cl–Cl) is already greatly disturbed; in the solid there are 12 and in the liquid 9·8.

Since the development in recent years of a more refined theory of liquids[1] has permitted the prediction of the number and position of nearest neighbours in a normal liquid, it was of particular interest to study the structure of liquid argon.

Because liquid argon at atmospheric pressure is only stable over a temperature range of 3·5° (boiling

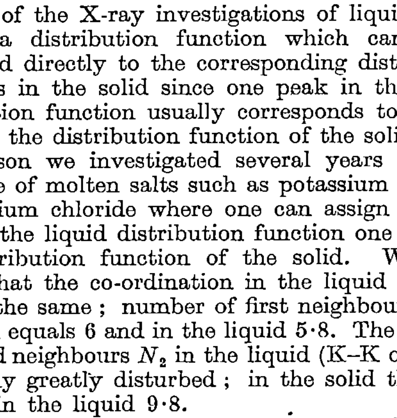


Fig. 1.

Diffraction pattern of liquid argon showing diffraction rings at (sin θ)/λ=0·152, 0·284, 0·410 and a faint ring is indicated at 0·59. The Laue spots are due to the mica windows.

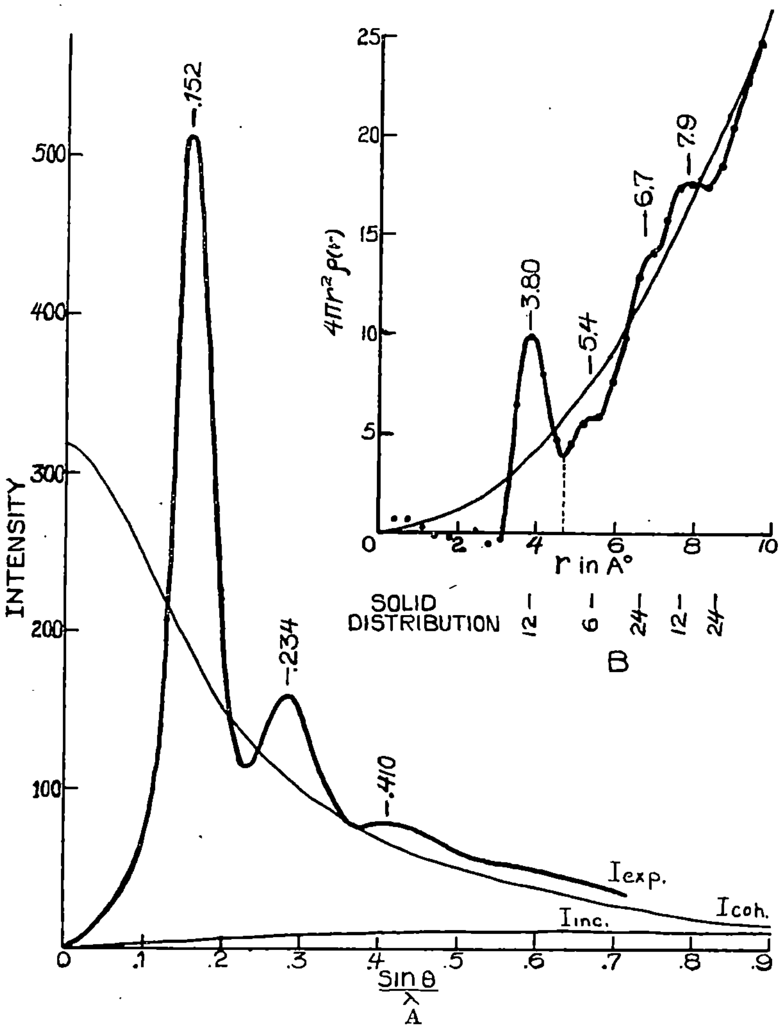


Fig. 2.

Iexp. (*A*) shows the microphotometer trace of the diffraction pattern reduced to intensity and corrected for absorption and polarization. Peaks at sin θ/λ = 0·152, 0·284, 0·410, a faint indication of a peak at 0·59. *B* shows the distribution function of the liquid and as a comparison the distribution in the solid is listed below the abscissa.

point —185·7° C. and melting point —189·2° C.) a special container for the liquid was constructed which made it possible to apply pressures slightly above atmospheric pressure during the exposure.

Pure gaseous argon is introduced into the cell and is there condensed under a pressure of 910 mm. mercury and at a temperature of 89·2° K. The liquid argon is held in a layer of about 1·3 mm. thickness between two mica windows, 0·01 mm. thick. The mica windows are sealed with indium gaskets to the copper walls of the cell proper which is cooled by a continuous stream of liquid air. This arrangement permits making a definite absorption correction (plane parallel layer) for the intensity measurements of the diffracted X-rays, and the diffraction pattern of the cell walls does not interfere with the liquid pattern itself. The absorption and the scattering of the cell walls are small compared to the corresponding values for the liquid. Monochromatic silver $K\alpha$ radiation reflected from a rock salt crystal was used in a vacuum camera, thus eliminating air scattering and continuous background.

The diffraction pattern, recorded photographically, shows three distinctly visible rings and a fourth ring is revealed upon closer inspection (Fig. 1).

Fig. 2 shows the experimentally observed intensity ($I_{\text{exp.}}$) properly corrected together with the coherent ($I_{\text{coh.}}$) and incoherent ($I_{\text{inc.}}$) scattering to be expected theoretically matched at (sin θ)/λ of about 0·7 for quantitative analysis.

From a Fourier analysis the atomic distribution curve in the liquid has been obtained and is shown in Fig. 2 *B*. The first neighbours are to be found at 3·8 A. (3·82 A. in the solid). The area under this peak gives the number of the first neighbours. From the various patterns which we have obtained this number was determined as 9·6, 10·1 and 10·3 nearest neighbours[2]. Further concentrations corresponding to the outer neighbours occur at 5·4, 6·7 and 7·9 A. The number of neighbours and their distances, as they occur in the solid (Fig. 2 *B*), indicate how far the liquid structure retains the arrangement found in the solid.

The results show that the type of co-ordination, as found in the solid, is retained in the liquid, but the transition solid-liquid in argon produces a disorder already pronounced in the reduction of number of first neighbours, as compared to N_1 = 12 in the solid.

Theoretical investigations[3] indicate that such a reduction in N_1 is necessary to account for the thermodynamical data. Recent investigations by O. K. Rice[3] lead to 10–10·5 nearest neighbours for argon in the temperature range of our experiments, in good agreement with the results obtained.

The substance of this work was reported at the Pittsburgh meeting of the American Physical Society during June 20–22, 1940.

K. Lark-Horovitz.
E. P. Miller.

Department of Physics,
Purdue University,
W. Lafayette, Indiana.
August 20.

---

[1] Fowler, R. H., and Guggenheim, E. A., "Statistical Thermodynamics", § 808, and following.

[2] Eisenstein, A., and Gingrich, N. S. (*Bull. Amer. Phys. Soc.*, 15, No. 2; April 1940) in a preliminary report give 7 atoms at 3·9 A. as nearest neighbours. This result, which seems rather difficult to reconcile with the theoretical predictions, was obtained with an experimental arrangement different from ours and in a different *p-T* range. It might be pointed out that at higher molal volume the curves of Rice[3] indicate a possible change in co-ordination, but scarcely so low as the preliminary results of these authors indicate.

[3] Fowler and Guggenheim, *loc. cit.*, and Rice, O. K., *J. Chem. Phys.*, 7, 136 and 883 (1939).

Resonance in the Chloracetic Acids

In a letter in Nature, H. O. Jenkins[1] has discussed the dissociation constants of the chloracetic acids, and concluded that the electrostatic inductive effect cannot account for the strength of the di- and tri-chloracids, although that of the mono-acid is quantitatively explicable on this basis[2], since "no functional relationship can be traced between μ_R (resultant moment of the C-Cl links) and K (dissociation constant)". This conclusion is, however, incorrect; for, if the bonds are tetrahedrally arranged around their carbon atom, the change in the electrostatic potential ψ ($= \mu\cos\theta/r^2$) at the carboxyl group (which is the inductive effect), should be proportional to the number of C-Cl links present, if μ, θ and r remain unchained for each link. That is, we should have

$$pK = pK_0 - qx, \quad . \quad . \quad (1)$$

where pK is the negative logarithm of K, for x chlorine atoms, pK_0 that of acetic acid, and q a constant; that is, the Ostwald-Wegscheider rule, although the resultant moments of the corresponding chlormethanes are not as 1 : 2 : 3.

The results given below show that the factor q decreases with x; hence the di- and tri-acids are weaker than they should be on this simple hypothesis, while Jenkins represents them as abnormally strong. This diminution in q can easily be explained. Smyth and McAlpine[3,4] pointed out that the dipole moments of the C-Cl links in CH_2Cl_2 are less than that of this link in CH_3Cl because of the mutual effect of the dipoles, and that this effect would probably be linear in the number of C-Cl links present. Hence we might expect

$$pK = pK_0 - sx + t\,(x - 1). \quad . \quad (2)$$

The available data on these acids are given in the accompanying table ($pK_r = pK - pK_0$):

	pK			pK_r		
	H_2O	MeOH	EtOH	H_2O	MeOH	EtOH
CH_3COOH	4·757[5]	9·762[7]	10·44[7]	0	0	0
$CH_2ClCOOH$	2·861[6]	7·838[7]	8·51[7]	−1·90	−1·92	−1·93
$CHCl_2COOH$	1·30*	—	6·89[7]	−3·46	—	−3·55
CCl_3COOH	—	4·92[8]	—	—	−4·84	—

* Ostwald's value.

The alcohol values must be considered since no accurate value for trichloracetic acid in water is available. As mean values for pK_r, therefore, we have −1·92, −3·50, −4·84. The equation (2) given, with $s = -1{\cdot}92$, $t = 0{\cdot}30$ predicts (−1·92) −3·52, −4·82 within the experimental error.

Further, since t is related to the bond-polarizability, for the fluor-acids it should be smaller, for the bromo- and iodo-acids larger, than for the chlor-acids. The only extant data are for propionic, α-brompropionic, and αα-dibrompropionic acids[9]: pK 4·87, 2·97, 1·48[9]. If equation (2) is valid, $s = -1{\cdot}90$, $t = 0{\cdot}41$ as compared with 0·30—in the right direction. It is suggestive that Wegscheider[10] found the largest deviation from equation (1) for substituted benzoic acids if the groups were 1 : 2 : 3, or 1 : 2 : 6 (carboxyl at 1), when the mutual interference must be a maximum. Exact calculation of the t term is not at present possible, but the order is reasonable[3,4].

Although explanations in terms of resonance and polarizability are not fundamentally opposed, Jenkins' relations between pK and n are of doubtful significance; resonance energy is not, in general, linear in the number of canonical forms. Finally, the resonance possibilities of the undissociated acids are very similar to those of their anions.

E. C. Baughan.

The University,
Manchester.

[1] Jenkins, Nature, **145**, 625 (1940).

[2] Kirkwood and Westheimer, *J. Chem. Phys.*, **6**, 506, 513 (1938).

[3] Smyth, C. P., and McAlpine, *J. Chem. Phys.*, **1**, 190 (1933).

[4] Compare also Sutton and Brockway, *J. Amer. Chem. Soc.*, **57**, 473 (1935).

[5] Harned and Ehlers, *J. Amer. Chem. Soc.*, **55**, 652 (1933).

[6] Wright, *J. Amer. Chem. Soc.*, **56**, 314 (1934).

[7] Minnick and Kilpatrick, *J. Phys. Chem.*, **43**, 259 (1939).

[8] Goldschmidt, H., and Aarflot, *Z. Phys. Chem.*, **117**, 312 (1925).

[9] Walden, *Z. phys. Chem.*, **10**, 650 (1892).

[10] Wegscheider, *Monat. Chem.*, **23**, 288 (1902).

Nature of the Cyanide-stable Portion of Cellular Respiration

In a recent and interesting review by Commoner[1], on the cyanide inhibition of cellular respiration, it is suggested that the cyanide-stable respiration is mediated through the yellow-enzyme system and is concerned with the oxidation of fatty substances, that is, compounds with a low O/C ratio. As tentative support for this hypothesis Commoner instances the relatively high Q_0^{CN} of liver, kidney and heart, the high flavin content of these tissues, and their low respiratory quotient (*R.Q.*) values.

Unfortunately, in advancing these ideas, no account has been taken of the possible contribution of purine oxidation to the cyanide-stable respiration. In the case of ox-liver it may be shown that such oxidation possibly accounts for the whole of this cyanide-stable respiration. From previous data of mine[2] the Q_{O_2} of 'minced' ox-liver may be calculated to be 1·8, of which the greater part was shown to be due to purine-base oxidation, and which is only slightly inhibited by cyanide. This value for Q_0^{CN} agrees quite well with that of 1·5–2·4 deduced by Commoner. For ox-liver, where uricase activity is absent, the *R.Q.* for purine-base oxidation is nil, so that if such oxidations account for any great part of the total respiration, the *R.Q.* value for the whole tissue will be much lower than unity. The low *R.Q.* values for liver do not therefore necessarily prove that fat oxidation is predominant. The high flavin-content of these tissues may also be accounted for by its xanthine oxidase activity in view of the identification of this enzyme as a flavin.

The evidence quoted in favour of Commoner's hypothesis is thus equally in favour of the view that the cyanide-stable respiration in mammalian tissues is to be identified with purine-base oxidation.

It is worth while pointing out that, with some plant tissues, notably those of carrot leaf and tea leaf, considerably higher concentrations of cyanide (*m.*/100) are required to bring about maximum inhibition of respiration. I have also recently shown that *m.*/100 cyanide is necessary for full inhibition of oxidation of catechols and *p*-phenylenediamine by a preparation of tea oxidase believed to be a cytochrome oxidase.

If, as seems likely, a cytochrome system is operating in these tissues the cyanide sensitivity of cytochrome must vary considerably according to the nature of the tissue. Until this variation has been properly investigated it seems premature to speculate upon the nature of the cyanide-stable portion of respiration as we may have here a case of incomplete inhibition of cytochrome oxidation by cyanide. There is also the possibility that in one tissue there may exist more than one cytochrome oxidase, varying in sensitivity towards cyanide.

Further details as to the cyanide sensitivity of the tea oxidase and its similarities to cytochrome oxidase will be published elsewhere.

E. A. HOUGHTON ROBERTS.
Tocklai Experimental Station,
Cinnamara, Assam.
June 21.

[1] Commoner, B., *Biol. Rev.*, **15**, 168 (1940).

[2] Roberts, E. A. H., *Biochem. J.*, **30**, 2166 (1936).

Faunistics and Ages of the East African Islands

ON an ordinary map the three low tropical islands of Pemba, Zanzibar and Mafia appear to bear a similar relationship to the African continent, from which they are all distant less than thirty miles. In fact, however, while the last two islands are on the continental shelf, Pemba is surrounded by water 2,500 ft. deep. Geological opinion is unanimous that Zanzibar and Mafia have been separated from the mainland only since Pleistocene times, but the geological history of Pemba is more uncertain. It has been maintained by Stockley[1,2] that this island has not been connected with Africa at least since Miocene times and his views have obtained wide currency. Actually the geological evidence on which this view is based is not very conclusive; for it is limited to the apparent non-existence of an unconformity between the (non-fossiliferous) Wete beds and the Chakechake beds which are dated as early Miocene.

Recently with the help of the British Museum (Natural History) we have examined the existing check-lists of the island vertebrates[3]. We find that many species have been admitted on inadequate or mistaken evidence while, on the other hand, many have to be added as a result of recent years collecting. We have analysed the revised check-lists and considered the results in conjunction with the fact that: (*a*) evergreen forest, probably the predominant formation in the islands in the past, has been greatly reduced in all of them, (*b*) owing to the topography and the currents the chances of Pemba's being colonized from the mainland (or another island) are, under present conditions, much smaller than those of the other islands. We find that the island faunas are all much poorer than that of the comparable strip on the mainland coast, with important families unaccountably absent, especially in Pemba. In specific composition the island faunas are entirely East African, except for certain Mascarene affinities, most of which appear in Pemba although there is none in Zanzibar. These peculiarities of Pemba are, however, contrary to expectation, exhibited almost entirely by flying animals, which tends to reduce their zoo-geographical significance. The most striking feature of the faunas is that endemism is low in all three islands and in all the vertebrate classes it is mostly subspecific and it is in no case generic. In addition to the single-island endemic subspecies there are several that are confined to Pemba + Zanzibar or Zanzibar + Mafia.

The faunistic evidence is thus in entire accord with the view that Zanzibar and Mafia are Pleistocene islands, and on the whole is strongly against the view that Pemba has been isolated since the Miocene or indeed much longer than the other islands. This conclusion would support the view[4] that the submarine scarps of Pemba may be connected with the extensive Pleistocene rifting in East Africa.

R. E. MOREAU.
R. H. W. PAKENHAM.
East African Agricultural Research Station,
Amani, Tanga,
Tanganyika Territory.
July 9.

[1] Stockley, G. M., "Report on the Geology of the Zanzibar Protectorate", Zanzibar (1928).

[2] Stockley, G. M., *Tanganyika Notes Rec.*, **3**, 32–36 (1937).

[3] Voeltzkow, A., "Reise in Ost-Afrika in den Jahren 1903–1905". Abt. 1, Stuttgart (1923).

[4] von Staff, H., "Wiss. Ergeb. Tendagurn-Expedition 1909–1912", Berlin (1914).

Camouflage in War-time

IN NATURE of August 3, p. 168, Mr. C. H. Rowe, criticizing schemes of camouflage painting in Great Britain, made a suggestion, based apparently on hearsay only, which implied that the interests of the Paint Manufacturers' Association was partly responsible for what he considered to be unscientific camouflage.

For the information of readers of NATURE, I must explain that the National Paint Federation is not consulted, and has no influence, on the selection of the shades of colours used or the camouflage scheme decided upon, and, moreover, has been instructed that it is not to act in an advisory capacity on such matters. Its duty is to provide paint to the shade of colour selected by, and made to a specification approved by, the Government Department concerned.

We cannot, therefore, accept credit for the excellence of many of the schemes that have been carried out in Great Britain, or blame for any failures.

S. K. THORNLEY.
National Federation of Associated Paint, Colour
and Varnish Manufacturers of the United Kingdom,
Cotswold,
Pixham Lane,
Dorking.

I HASTEN to apologize to Mr. S. K. Thornley and to readers of NATURE for the statement made in my letter. The fact that I made clear that my information was entirely hearsay, and that it was from a source which I have had, hitherto, no reason to consider unreliable, does not absolve me. I should, of course, have consulted the Paint Federation first.

Mr. Thornley's prompt denial of responsibility is very welcome, but perhaps he will go further and tell us who it is that approves the specifications for the shades of colour and the paint for Army camouflage ordered from his members. If he can do this, we may be one step further in tracking down the monster of khaki and green 'kidneys' to his lair.

C. H. ROWE.
41 Camden Square,
London, N.W.1.

RESEARCH ITEMS

Roman Policy in Northern Britain

The extent to which recent archæological excavation demonstrates the development of policy in Roman Britain and the underlying causes, upon which recorded history is supplemented, is indicated by I. A. Richmond in *Antiquity* of September 1940. The political character of northern Britain in the period is determined by two closely related factors—forest and fell—which gave cover to enemies and prevented the growth of flourishing agricultural communities capable of developing social instincts receptive of civilization. From A.D. 43–69 the Romans depended upon alliance with the independent Brigantes centring in West Yorkshire. The problem of controlling the north did not arise until the alliance was broken by the Brigantes themselves. York was then occupied, permanent advance posts established, and Rome committed to the policy of Highland conquest which culminated in the conquest by Agricola of the country south of the Caledonian Highlands and the building up of an elaborate network of roads and a system of forts manned by auxiliaries acting as a police force. The reduction in the legionary forces weakened this system until A.D. 122 when the frontier was withdrawn and Hadrian's Wall was built, at first in turf and then in stone. This produced, however, a stalemate which led to a reversion to the policy of annexing southern Scotland. A turf wall was built by Antoninus between Forth and Clyde, with outposts beyond, controlling routes to the Highlands. The resulting tranquillity allowed the growth of prosperity and orderly life among the Brigantes. At the close of the second century Roman imperial politics drained Britain of troops. This led to tribal incursions from Caledonia and disasters lasting for ten years until order was restored by Severus in a peace which endured for a hundred years, and brought with it a change in outlook. Local recruitment for the auxiliaries converted them from a dominating to a territorial force, while the border tribes became Roman protectorates. The tribe was merging into the nation. The final stage came when the Picts broke through the Wall; and after their devastations had been checked, Rome delegated the north to a strong local administration in which the Brigantes enjoyed an Indian summer of prosperity, and communal instincts were fostered by a steady inculcation of responsibility.

Pre-Portuguese Bronze Castings from Benin

At the time of the conquest of Benin and for some time after, it was assumed that the Beni had learned their bronze casting from the Portuguese. This is not justified by a comparison with contemporary Portuguese technique. From about A.D. 1150 until A.D. 1280 all bronze and brass work at the court of Benin was made at Ife, but eventually Oba Oguolu sent to Ife for a worker to establish bronze and brass work in his country. Ighe-igha was selected to go to Benin. Not only was he a great artist but he was also a great teacher; and at his death he was deified and to this day he is worshipped by the brass smiths at Idunmwu Igun Eroumwo, the quarter of the royal brass founders. Three examples of early bronze casting have been described by Eva L. R. Meyerowitz (*Man* of September 1940). They are in the possession of the Oba of Benin and were excavated in recent years when additions were being made to the royal palace which stands on the ancient cemetery. Of these the first is a badge of office of a priest of Olokun. These badges in older days were housed in a shrine dedicated to the god Olokun in Benin and carried by the priests on ceremonial occasions. The badge is a large bronze casting in semi-circular shape showing Olokun, god of the waters, supported by two attendants, a characteristic theme in Benin art. The Obas identified themselves with Olokun, but their representations are to be distinguished from those of the god by the fact that their feet are human while the limbs of the deity usually branch out into catfish. For stylistic and other reasons this specimen is assigned in date to A.D. 1350–1450. The second example is a badge of the Shango priests, a large bronze casting of semi-circular shape with a ram's head. It probably belongs to the same period. The third casting is a triple dagger surmounted by three heads, representing Olokun on the left, Elusu with a fish body in the middle and Olokun's second wife on the right. Elusu, a sea-goddess, is mainly worshipped at the coast around Lagos, and it may be that this dagger did not originate in Benin.

Antihormones

The term hormone is widely known to the layman as is the fact that these substances can be used in the treatment of certain disturbances of the endocrine system, but what is not so generally realized is that animals can also produce neutralizing substances to which the name antihormones has been applied. J. B. Collip, H. Selye and D. L. Thomson have furnished a very useful survey of what is known of these substances (*Biol. Rev.*, 1940), particularly the antigonadotrophic and antithyrotrophic hormones, since these have been the subjects of the most intensive researches. The authors emphasize that it has been definitely established that "pretreatment with certain hormones will cause the appearance in the blood of principles antagonistic to these hormones". The presence of neither the primary organ itself, that is, the gonad or the thyroid gland nor of the hypophysis is necessary to the production of these substances. Whether they are antihormones or antibodies as some authorities claim is difficult to determine, and in any event is perhaps largely a question of definition, but they are definitely specific in their action. In addition to the main antihormones of these two groups which are fully dealt with, the possible existence of a number of others is considered.

A New Bird from Virginia and its Fate

The first new species of bird to be discovered in the continental United States in twenty-one years has just been found in West Virginia by Karl W. Haller, according to the Smithsonian Institution news service. The new species, *Dendroica potomac*, resembles the yellow-throated warbler in colouring, but its song is like that of the parula warbler. It is odd that a fairly conspicuous bird, not particularly shy in its habits or habitats, should have remained unrecognized for many generations, but it may have escaped notice because of its resemblance to other warblers. There is the other possibility that this new species may be that rarely observed new creation, a fertile cross between two species. The species is founded on two specimens. Mr. Haller was attracted first by the song of a male bird, which he shot. "The real significance of the find came when another bird was shot . . . a female almost identical with the male, and unquestionably fertile. She would soon have laid eggs if not collected." So for all we know, possibly one of Nature's rare achievements, a fertile cross, may have been exterminated even before it was described. But at any rate it is represented by a name in scientific nomenclature, a description, and two skins in a museum.

Reactions of Miracidia of Sheep Liver-fluke

IN the course of experiments testing some reactions of the ova and miracidia of *Fasciola hepatica,* Henry J. Griffiths exposed many representatives of eleven species of Canadian molluscs to miracidia (*Canadian J. Research,* **17,** 205; 1939). Individual molluscs were exposed and kept under observation during exposure, being killed later and examined for stages of the parasite. These examinations as well as attempted mass infections in 25 tanks of snails yielded no evidence that any of the species harboured the liver-fluke. Yet on exposure to miracidia all the species were attacked, those belonging to non-Lymnæa groups almost as readily as the Lymnæa types themselves; but the parasite, which attached itself to any exposed portion and might remain attached for 10 minutes endeavouring to penetrate the host's tissue, ultimately dropped off. Although the attacks were deliberate in many cases, in others they were accidental, and miracidia were often seen swimming close to the snails, and even to a known vector *Gyraulus ferruginea,* without showing any sign of attraction or of attempt at attachment. This is in agreement with the conclusions of Mathes, that although miracidia avoid hard bodies such as stones, they show no sign of chemotaxis in finding the intermediate host.

The Eriophyidæ or 'Gall-Mites'

DR. KEIFER's "Eriophyid Studies" (Pts. 1–9; *Bull. Dept. Agric.,* Sacramento, Calif., U.S.A., 1938–1940) constitute one of the most important contributions to this subject published, even surpassing those of the great Viennese zoologist, Dr. Alfred Nalepa. He describes numerous new genera and more than one hundred new species. Those who may have overlooked these valuable and very well illustrated papers, containing 139 plates of more than 1,000 figures, will be pleased to learn that Dr. Keifer proposes at a later date to republish these "Studies" as an "organized whole". Dr. Keifer regards the term 'gall-mites' "a misnomer for the group, as less than 10% of the species cause plant deformations".

Cytological Studies of Salix Hybrids

A. HÅKANSSON (*Hereditas,* 24, 1–31; 1940) has published the results of his cytological studies of hybrids between species of Salix which were made by Heribert-Nilsson. Among the hybrids were two which arose from crossing eight different species of Salix together. These two shrubs were tetraploid and had a regular meiosis. Some other hybrids involving several diploid species were diploid and showed a regular meiosis. In the F_2 of the cross *S. viminalis* × *S. caprea,* both of which are diploid, there was a shrub with a similar morphology and cytology to the tetraploid species *S. cinerea.* Even the cross *S. viminalis* × *S. phylicifolia,* a cross between a hexaploid and a diploid species, produced a tetraploid plant which had a regular meiosis.

Structure and Formation of Antibodies

A PAPER propounding a theory of the structure and process of formation of antibodies was read by Linus Pauling before the annual meeting of the U.S. Academy of Sciences held during April 22–23. This is based on structural information about simpler molecules, and is considerably more detailed than any earlier theory. The theory accounts for many facts, such as the observed antibody-antigen ratios in precipitates, the inhomogeneity of antibodies to a given antigen, and the independence of action of antigens in an immunizing mixture. Among the predictions based on the theory are the following: that the denaturation of antibodies is irreversible; that different antibodies on denaturation and attempted denaturation become identical; that decrease in specificity of the antibody and decrease in antigenic power (amount of antibody produced) accompany increase in number of strong groups in the antigen; that a non-protein and non-polysaccharide substance may have antigenic power if it contains suitable groups and its molecules or particles are sufficiently large; that the synthesis of antibodies *in vitro* might be achieved by denaturing serum globulin and removing the denaturing agent in the presence of an antigen or haptene.

The Probability Concept

THE probability concept was considered in a paper read before the annual meeting of the U.S. National Academy of Sciences (April 22–23) by E. C. Kemble. The long-standing controversy over the nature of probability may be resolved by the type of operational analysis so fruitful in physics. Probability is related to our subjective sense of expectancy in much the same way that a thermometer reading is related to our subjective sense of heat and cold. Probability can be defined as a number derived by standardized mental operations from a definite state of information. In so far as it is dependent on information it is subjective. In so far as the evaluation of probabilities from given data is standardized in a manner acceptable to many persons the concept becomes objective. There is no *a priori* necessity for a *single* rule for evaluating probabilities from all states of information, and one must admit that where the information is vague *no* calculation of an acceptable probability is possible. Evaluation of probabilities on the basis of a principle of indifference is appropriate to one type of informational situation, whereas calculation from relative frequencies in a collective is appropriate to another. There is use for both types of probability in practical and scientific matters. Either one can be used with the standard calculus of secondary probabilities from primary probabilities. However, there is a sharp distinction between the totality of implications which can be drawn from the two corresponding states of information. Failure to observe this distinction is a common and serious error in probability calculations.

EASTER ISLAND ORIGINS*

A FRANCO-BELGIAN expedition, initiated by the Institut d'Ethnologie and the Muséum national d'Histoire naturelle of Paris and supported by the Government and scientific institutions of Belgium, was engaged during 1934–35 in the investigation of the archæology and ethnology of Easter Island. The members of the expedition were Alfred Métraux, Charles Louis Watelin (archæologist), Dr. Henri Levachery of the Musées Royaux d'Art et d'Histoire, and Dr. Israel Drapkin, of Chile. Owing to the death of M. Watelin on the outward voyage, the work of archæological investigation fell to Dr. Levachery, and will be the subject of separate treatment.

In few places in the Pacific does so little remain of the ancient culture as in Easter Island. The present population of 456 natives is entirely derived from the 111 natives left after the abandonment of the island by the French missionaries in 1872. There is thus little chance for the preservation of old traditions. One living person alone survives who witnessed the functioning of the old culture; and she is now more than one hundred years old and of uncertain memory. The principal repository of tradition is the oldest man on the island, who provided the Routledges with their information and is now sixty years of age.

On the racial character of the Easter Islanders two divergent views, based on the evidence of cranial material, are held. Of these, one, while recognizing a Polynesian connexion, seeks to tie up the Easter Islanders with Melanesians or Australians. The second denies the validity of a relationship with non-Polynesian groups, but fails to confirm their Polynesian origin. Dr. I. Shapiro, after a brief review of the evidence, here inclines to the conclusion, based on the evidence of his own measurements of the living, that the Easter Islanders are "definitely Polynesians of a somewhat specialized and exaggerated type, isolated by migration and intensified by inbreeding". Blood-groupings, not yet published, confirm the relationship with Polynesia rather than Melanesia. It is noted that the grammar of the Easter Island language is typically Polynesian and presents no striking individuality.

According to native tradition Easter Island was peopled by Hotu-Matua, who came with two canoes from the west and had been a king in Marae-renga. He was not indeed the first man to land on the island for six other men had preceded him. To Hotu-Matua is attributed the introduction of cultivated plants and all land animals known to the natives, though many of both were demonstrably introduced by Europeans. Among other culture elements assigned to the origination of this hero are the signs of the famous Easter Island tablets. It is considered probable that before the coming of the Europeans there is no réference to Easter Island in the traditions of other islands of Polynesia.

Had Easter Island kingly traditions similar to those of other parts of Polynesia, most of its mysteries might be solved. They do not, however, exist; and the results of the investigations that have been made have produced only lists of kings, arbitrarily formal and with only uncertain and conjectoral geneological sequences.

Next to the stone statues the most famous products of Easter Island art are the wooden images representing emaciated or decaying human beings. Although of ancient origin, the more exaggerated and grotesque have been manufactured to suit the tastes of visitors. The carving of these figures is the only regular industry of the island. The bird-man images—the bird-man is one of the most frequently represented figures in the petroglyphs—demonstrate the extent to which conventional motifs were imposed upon all Easter Island wood carving. Like the stone images, the wooden figures are enigmas and their true significance was not even clear to the natives fifty years ago. They were kept in the houses, and were in the nature of secondary deities. There are natives who still conceive that they are identical with spirits of the dead. Such wooden images of humans are common to the cultures of eastern and central Polynesia, but the emaciated condition of the Easter Island images is foreign to other Polynesian art, except that of Chatham Island.

One object of the expedition was to record all the petroglyphs which could be discovered. In all, 300 were noted. At Orongo, where petroglyphs were first recorded and studied, the bird-man, with the head of a frigate-bird on a crouching human body, is represented in most of the petroglyphs. Only here are the drawings in high relief. Elsewhere they are pecked, and most of the designs represent sea animals. The most spectacular group is near Hanga-o-bonu. It is composed of intermingled motifs which include boats. Human figures are rare. The style of the designs resembles that of the signs on the wooden tablets.

The funerary cairns or *ahus* are the most common monuments in the island, and give it most of its individuality. Probably they correspond to the *maraes*, or sanctuaries of central Polynesia. There are four types, but all are essentially mounds of stones. The large image *ahus*, in which a retaining wall has developed from the heap of stones, are the masterpieces of Easter Island architecture. These structures have numerous affinities with religious structures in other parts of Polynesia.

Cut stones are used extensively on Easter Island. In three other regions only in Polynesia—the Marquesas, the Society Islands, and Tonga—was stone cutting well developed. The excellence of Easter Island stone cutting is due to the use of hard vesicular basalt. It shows an elaborate technique.

The quarry of the giant statues on Rano-raraku crater is one of the most spectacular places in the island, and the fame of Easter Island rests largely upon it. From here come almost all the statues or *ahus*. The quarry on the western slope contains a helter-skelter of unfinished statues, of niches from which finished statues have been removed, and of statues in process of removal. There are 157 statues in different stages of completion. It is possible, owing to their great size, that some were never intended for removal. The images of Rano-raraku which stand below the crater, sixty in all, are not only the largest, but also they alone, among all the giant statues of Easter Island, have not been pulled down. Small stone images are scarce, and differ widely in style from the statues; but they are probably ancient. The heads of many of the statues once bore a big cylinder made of red vesicular tuff as a headdress. These range from 1·2 m. to 2 m. in height, and from 1·6 m. to 2·7 m. in diameter. Some had a knob or boss at the top. A slight concavity at the bottom fitted on the head of the statue. It is thought they were a crude attempt to ornament the statues with a structure similar to the top-knot.

---

* Ethnology of Easter Island. By Alfred Métraux. Honolulu, Hawaii. Bernice P. Bishop Museum. Bull. 160. Pp. vii + 432 + 7 pls.

The carving of human images from wood and less often from stone is one of the culture traits which distinguish eastern and marginal Polynesia from western Polynesia, where carving of human figures is less developed. Large stone images are carved only in the Marquesas, Raivavae, and Easter Island. Elsewhere in Polynesia wood carving preceded stone carving. The first immigrants to Easter Island probably came from eastern Polynesia, and were there acquainted with carving human figures from wood.

In the religious beliefs the bird-man cult held a most prominent place until the second half of the nineteenth century. As reconstructed from second-hand information it has no parallel in the rest of Polynesia. Though incarnation of gods in animals is a fundamental character in Polynesian religions, nowhere else do open competitions result in the election of a sacred man.

The tablets of the Rongarongo man—the famous wooden tablets covered with hieroglyphs—had associated with them sacred chants, which were sung by learned men or bards. Comparative study suggests that they are not so much inscriptions of the words of the chants as mnemonic. They are a puzzle to science, and the most complicated problem of Easter Island culture. Some tablets dealt with ceremonies, others were parts of ceremonies themselves. They were never read, but were used during chanting. No methodical analysis of the script has as yet been made. It is not phonetic or syllabic, but it may be a form of pictography. There is no doubt that the signs are symbolic and not decorative.

Parallels to the Easter Island tablets are found in the mnemonic devices of the Marquesas, which consist of a cylindrical bundle woven of coconut fibre, from which hang knotted cords. This bundle is often shaped like a human figure, and is supposed to contain the story of the gods. Other truly analogous mnemonic devices were developed in the Cook Islands, Tuamotus, the Society Islands, etc.

The mystery of Easter Island rests on the assumption that the culture of the island was too elaborate to have been invented by the inhabitants found there by the first European visitors. It was assumed that the monuments of the island were the expression of a civilization which had been destroyed either by a natural disaster or by invasion. It has been assumed also that the Polynesians represent a second wave of invasion; but of any theories of the origin of the original inhabitants the only one worthy of scientific consideration is that they were Melanesians. The parallels, adduced in support, however, are vague and indefinite.

As the result of the careful and exhaustive investigations by the Franco-Belgian expedition of the ethnological data now available, including material culture, past and present social structure, and religious belief, it is concluded that Easter Island was occupied by a single wave of immigrants belonging to the Polynesian race. Each region of Polynesia stressed and perfected an aspect of its culture—the Marquesas tattooing and the Maoris wood carving, and jade ornaments; and so also Easter Island came to develop giant statues without the interpolation of a sunken continent or a Melanesian invasion. Easter Island, in fact, is a local Polynesian culture which developed from an archaic and undifferentiated Polynesian civilization.

FLIGHT AND HABITS OF THE HUMMINGBIRD

SOMETHING close to perfection in flight has been achieved by the tiny hummingbird, the small but relatively powerful wings of which make possible speeds of close to fifty miles an hour and ability to manœuvre in the air probably superior to that of any other flying creature. This is explained by Dr. Winsor M. Tyler in a bulletin recently issued by the Smithsonian Institution, in which are described the habits of the familiar ruby-throated hummingbird, the only species ever encountered in the Eastern United States.

The wing beats sometimes are at a rate of seventy-five a second. The bird can take off from a perch in about seven-hundredths of a second. It can remain almost still in the air with about fifty-five wing strokes a second.

Perhaps the hummingbird's greatest achievement, however, is its ability to fly backward. This has often been reported and as often questioned as impossible; but recent photographic technique has shown that the reverse flight is an actuality. This is explained as follows:

"In backing away from a flower or feeding tube the hummingbird stands almost vertically in the air with its tail pointing downward and a little forward. In this pose its wings beat horizontally, and what would be the downward half of each complete wing stroke if the bird's axis were parallel to the ground forces the air forward, away from the bird's breast in its upright position, and drives the bird backward. Then, on the return half-stroke, the whole wing is rotated at the shoulder joint so that its upper surface strikes the air, and, driving it downward, balances the pull of gravity."

Other sidelights on this creature's ways of life are explained by the author. The hummingbird's spring migration northward keeps pace with the opening of its favourite flowers. Males and females usually migrate in separate groups. In fact, they remain apart most of the time, except for brief mating periods. The nest is a model of bird artistry, lined with soft plant down and covered on the outside with bits of lichen. It is usually entirely the work of the female.

The newly hatched bird is no bigger than a pea and entirely naked. The young probably are born blind. Growth is very rapid, and in less than two weeks the young birds are almost as big as their parents and able to leave the nest.

The hummingbird sips the nectar from blossoms, but a good part of its food consists of insects. Presumably it was originally exclusively an insect eater, specializing on those types likely to be found around blossoms. In this environment the bird has acquired an unappeasable taste for sweets. A single individual has been observed to devour two teaspoonfuls of sugar daily. A human being with a comparable capacity would devour about fifty pounds.

They show a strong preference for red flowers. This, the author believes, is not due to the attractiveness of the colour *per se* but to the fact that it is always the most striking against a green background.

Hummingbirds often seem to be nervous and irritable. They are intolerant both to each other and to other birds. In spite of their smallness they will attack much larger birds which invade their neighbourhood, relying on their marvellous dexterity of flight to win the conflicts. The special form of attack against a larger bird is a form of 'dive bombing'.

The song is high-pitched and has a "petulant" quality, reflecting the bird's irritable nature. Sometimes the notes are "angry-sounding, mouse-like squeals".

Because of its tiny size the hummingbird meets perils unknown to other birds. There are instances recorded where it has been caught in spider webs. It may become impaled on thorns or stuck to thistles or milkweeds. One instance is cited in which a bird was attacked and destroyed by a dragonfly.

'ISLAND' FAUNAS ON THE MEXICAN PLATEAU*

Prof. Edward H. Taylor,
University of Kansas

Animal life of Mexico is greatly diversified, and may be primarily divided into the lowland types and highland types. The lowland animals are largely an influx from Central America, after the union of Mexico and Central America. The highland fauna is itself extremely diversified. Considering primarily the herpetological faunas, very few species, if any, have spread over the entire highlands. A great many of the species appear to be distributed in groups occupying very limited areas—much like the distribution of animals in a group of islands. Thus south of the Balsas River there is an area that can boast of 64 species—some 22 snakes, 20 frogs and toads, 22 lizards, not to be found elsewhere in the world; and a total absence of salamanders.

To the east a distance of perhaps two hundred miles in the higher part of the adjoining State of Oaxaca is another 'island', perhaps half as large as the preceding, that has 31 species of reptiles and amphibians not known elsewhere—including 7 salamanders, 10 snakes, 9 lizards and 5 frogs. The exploration of this 'island' has scarcely begun.

The highland region about the City of Mexico and to the east, including the great volcanoes of Orizaba and Popocatepetl, the highest, coldest part of the plateau, has some 25 amphibians and reptiles not known elsewhere, including 5 salamanders, 10 snakes, 10 lizards, and 8 frogs and toads. Just north of this plateau cap is an area which includes much of the State of Hidalgo, which has some 30 species that are not known elsewhere in the world, and still is little explored. Farther north around the city of Saltillo is another, similar, but as yet little-explored, area with several species confined to the highlands of this region. Other similar 'islands' occur in the little-explored western Sierra.

Thus in this highland mass of Mexico these groups total about 280 species of reptiles and amphibians, known from nowhere else in the world, each group occupying its own limited area. Moreover, most of these areas are not contiguous with adjacent 'islands', but are usually separated by some distance. In the Rocky Mountains north of New Mexico and Arizona —a territory nearly as great as that of the Mexican highland—there is apparently not a single endemic species of Reptilia or Amphibia that has evolved.

This 'island-like' grouping of the reptiles and amphibians is not due to strongly differentiated physical or environmental factors of rainfall, temperature, etc., that might normally be expected to limit animal groups into faunal districts; it may in some measure reflect altitude; but they are not typical 'fauna regions'. It would appear that this has been due to ancient isolation.

That these island-like conditions of distribution obtain on the Mexican highlands strongly suggests that much of the evolution of Mexican animals took place prior to the uplift of the highlands; that in this region prior to the uplift there existed groups of islands surrounded by shallow seas—an archipelago perhaps similar to the West Indian Islands of to-day, that had been formed by subsidence of a once continuous land mass that had a rather homogeneous fauna.

Evolution continued for long periods, each island isolated from its neighbour changing the original stock as it could. Then with re-elevation the faunas still reflected their individuality by these island-like areas on the highland.

Further study of the faunas points strongly to the presence of two islands where the present peninsula of Lower California exists to-day, and the probability that the upper was joined to the Mexican mainland and separated from California; that the union between Central America and Mexico was not made until long after the uplift of the Mexican highlands; that the western coast has been sinking in relatively recent times, as shown by close relationships between the faunas of small islands and the mainland along the western coast.

---

* Substance of a paper read before the Eighth American Scientific Congress held at Washington during May 1940.

DECONTAMINATION OF ELECTRICAL EQUIPMENT

THE Government has published full instructions for decontamination of electrical equipment, but, of necessity, these relate only to general conditions and do not deal in detail with the many specialized materials used by the electrical industry. In order to obtain more definite guidance on decontamination of equipment, the North Eastern Electrical Supply Co., Ltd., convened a committee to study this question. A report was submitted to the Ministry of Home Security and was amended according to its observations. The final report approved by the Ministry is now being issued by the Electricity Commission and should form a valuable guide to the industry.

After briefly reviewing the general principles of decontamination, the report states that there will be no immediate danger from the continued operation of contaminated plant, except in the case of bad contamination, when the electrical contamination of the plant itself may alter. There is, however, danger to personnel from the vapour which may arise from the contaminated gear if it becomes warm. The first action is directed towards removing the danger to personnel. Where it is impossible to shut down the plant to carry out complete decontamination, as much as possible should be done and danger notices should be placed on the remaining contaminated parts, with suitable ventilation provided to remove the vapour being given off. Successful decontamination is chiefly dependent on prompt application of the necessary treatment.

Insulating panels and metal can be cleaned by rags soaked in solvent and removing the excess solvent by clean rags. Sometimes solvents are effective. It is necessary in bad cases to strip the surface. Coils should be treated with solvents preferably sprayed on and afterwards wiped dry. In the case of electrical machines, they should be cleaned with solvents as much as possible, and then given a run at full load. The heat generated will vapourize any remaining liquid and so complete the decontamination. Adequate ventilation must be provided to remove the vapour and a gas inspection officer may be required before the plant can be declared free from contamination.

Lead-covered cables can be cleaned with solvents; but when the sheath is damaged the cable should be replaced. In the instructions the effect of blister gases on various insulating materials is shown in a lengthy table. In general, mustard gas penetrates a material, either by creeping along pores or fibres as in paper and brickwork, or by dissolving in the material as in bitumen, paraffin wax, etc. The first-mentioned class allows the gas to evaporate and can be affected by the destructive action of moisture on the gas. The latter class retains the gas for a long time, and only complete destruction is satisfactory. With regard to the type of solvent to be used, light oils have the advantage of being neither toxic nor inflammable. Paraffin is cheap and easily obtainable. A footnote is added to the report on the decontamination of areas affected by calcium arsenide. The most practical method is to hose the area liberally with water. This will at once liberate the arsine gas, which will be rapidly dispersed. Respirators must be worn but anti-gas clothing is unnecessary. On electrical apparatus the powder must be swept off and a blower used on the inaccessible places.

FORTHCOMING EVENTS

Tuesday, October 8

Institute of Fuel (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.15 p.m.—Mr. W. Boon: "Some Thoughts on Coke".

Illuminating Engineering Society (in the Lecture Theatre of the Royal Institution, 21 Albemarle Street, London, W.1), at 2.45 p.m.—Prof. J. T. MacGregor-Morris: "The Arc as a Standard of Light" (Presidential Address).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Teacher of Mathematics, Physics and Physical Training at the Barnsley Mining and Technical College—The Principal, Technical College, Church Street, Barnsley (October 9).

Deputy Borough Electrical Engineer—Mr. G. R. Spurr, Borough Electrical Engineer, Electric House, Church Hill, Walthamstow, E.17 (October 18).

Depute Engineer and Manager of the Electricity Supply Undertaking—The Engineer and Manager, Electricity Supply Department, Dewar Place, Edinburgh 3 (October 18).

Graduate Lecturer in Engineering—The Principal, Wigan and District Mining and Technical College, Wigan.

Assistant Engineer for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9316).

Assistant Master for General Science and Mathematics at the Bath Technical College—The Director of Education, Education Department, Guildhall, Bath.

Teacher of Engineering (Practical Mathematics, Engineering Drawing and Engineering Science) at the Falmouth Day Continuation and Technical School—The Clerk to the Governors, District Education Office, Falmouth.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Edinburgh and East of Scotland College of Agriculture. Calendar for 1940–1941. Pp. 66. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [249

British Museum (Natural History). Economic Leaflets No. 4: Psocids, Book Lice, Dust Lice, etc. Pp. 4. ½*d*. Economic Leaflets No. 5: Crickets. Pp. 4. 1*d*. (London: British Museum (Natural History).) [249

Other Countries

Bulletin of the American Museum of Natural History. Vol. 76, Art. 9: Lagomorpha and Rodentia other than Sciuridæ, Anomaluridæ and Idiuridæ, collected by the American Museum Congo Expedition. By Robert T. Hatt. Pp. 457–604+plates 7–19. Vol. 77, Art. 33: A Revision of the Rotatorian Genera Brachionus and Platyias, with Descriptions of One New Species and Two New Varieties. By Elbert H. Ahlstrom. Pp. 143–184+plates 2–20. Vol. 77, Art. 4: Studies on the Earliest Primates. By George Gaylord Simpson. Pp. 185–212. (New York: American Museum of Natural History.) [179

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 35: Progress of Veterinary Research in India during the Past Twenty-five Years. By F. Ware. Pp. ii+37. (Delhi: Manager of Publications.) 1.2 rupees; 1*s*. 9*d*. [179

Records of the Botanical Survey of India. Vol. 5, No. 5: Plants of the Lloyd Botanic Garden, Darjeeling. By Dr. K. P. Biswas. Pp. iv+369–478. 3.14 rupees; 6*s*. 3*d*. Vol. 14, No. 1: A Revision of the Labiatæ of the Indian Empire. By Dr. S. K. Mukerjee. Pp. iv+228+viii. 5 rupees; 8*s*. (Delhi: Manager of Publications.) [179

New Zealand. Fourteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 100. (Wellington: Government Printer.) 2*s*. [179

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 30, Memoir No. 1: The Jurassic Brachiopoda of the Namyan Beds of the Northern Shan States, Burma. By Dr. M. R. Sahni. Pp. v+46+4 plates. (Calcutta: Geological Survey of India.) 2.10 rupees; 4*s*. 3*d*. [189

Melk in het buzonder als Zingelingenvoedsel. Door Dr. J. H. de Haas an Ir. O. Meulemans. (Uit de Kinderklinik der Geneeskundige Hoogeschool te Batavia.) Pp. vii+104. (Batavia: M. Vervoort.) 2.75 f. [199

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 99: Studies on Chemical Weed-Killers with Special Reference to Skeleton Weed. By C. G. Greenham, Dr. G. A. Currie and F. E. Allan. Pp. 48. (Melbourne: Government Printer.) [259

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 12, 1940 No. 3702

SCIENCE AND THE NATIONAL WAR EFFORT

THE recent changes in the membership of the Cabinet, coming as they did on the same day as the announcement of the appointment of a Scientific Advisory Committee responsible to the Lord President of the Council (see page 485 of this issue), will probably have overshadowed in the public mind the significance of this Committee. A scrutiny of the terms of reference, and consideration of the qualifications and standing of its members, however, will bring the realization that in this Committee we have a means of putting science into direct contact with the innermost councils of the Empire. How much this may mean for the outcome of the present conflict, and beyond that, will depend on the speed with which the Committee pursues its inquiries, the vigour with which it urges its conclusions on the Government, and a receptive mind on the part of the leaders of the country.

During the past twelve months, there has been a feeling among scientific workers, both as organized bodies and as individuals, that insufficient use was being made of their knowledge and special qualifications. Reference has frequently been made in these columns to the dissatisfaction and sense of frustration, for which the only answer hitherto has been a certain amount of lip-service to science from responsible politicians. We have been told time and time again that this is a scientific war, and that the German use of scientific developments must be met by ever more intensive application of science ; but little came of it, apart from extensive development of the scientific departments within the ministries. There seemed no realization of the need for a major step in the improvement of the organization, for the provision of a focus through which the increasing activities of scientific departments could be linked together. Sir William Bragg hinted at the prevalent anxiety in his presidential address to the Royal Society last November ; and he made a definite suggestion for the constitution of a consultant panel of eminent scientific workers, that would give advice and also be kept informed of the progress of events, so that "it might foresee occasions and needs". In other words, Sir William was suggesting more than the usual committee, pursuing its investigations and making recommendations which would be forwarded to the Government through the usual departmental channels and thereby subjected to delay and, alas, often ill-informed and destructive criticism. He asked for a body with access to, and authority with, those who lay down policy.

Such a committee would, of course, have been a new departure in the system of government in which we have grown up. But evolution rather than revolution has ever been a characteristic of political history in Great Britain, and Sir William Bragg's suggestion, elaborated no doubt in association with the officers and Council of the Royal Society, was, we presume, rejected by the Government on other grounds than novelty. The scheme now adopted, although superficially it may resemble the older one, has an important difference. The members of the Committee, apart from the chairman, are indeed all fellows of the Royal Society, but three of them are in the public service, namely, the secretaries of the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council, and the other three are the president and secretaries of the Royal Society. By this means a judicious mixture of the official and unofficial is provided, and the members should be in intimate contact with scientific and technical developments wherever they occur.

The need for outside and independent criticism of the activities of scientific and technical departments under Government control will readily be conceded. This is no reflection on the integrity and capabilities of the many eminent men working in these departments ; it is one of the defects of the present system. Few of the political leaders of Great Britain have anything but a nodding acquaintance with science or technology, and they can get little help in this field from Civil Servants in the higher administrative posts. In consequence, the scientific and technical officers of departments become either the servants of the administrative side, with little possibility of taking a hand in the formulation of policy, or else—and more rarely—their advice is followed blindly. Neither result is likely to be productive of the critical yet flexible and responsive attitude of mind which is required under modern conditions. Coupled with the departmental scientific advisers there should be a source of independent opinion, to the recommendations of which the minister himself may be expected to give weighty consideration.

There are in existence several such advisory councils or committees, which have fully justified the hopes entertained of them. The three research departments of the Privy Council, namely, the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council, have all worked from their formation by means of councils or committees consisting mainly of independent scientific workers, which have largely defined policy as well as administered research projects. The scientific work of the National Physical Laboratory is controlled by a body appointed by the Royal Society. The Aeronautical Research Committee, which includes many independent members, has for many years been responsible for research and development in aeronautics in Great Britain, as its many publications have shown.

To come to appointments directly concerned with warfare, there is the Committee for the Scientific Survey of Air Warfare, set up in 1935, which came to an end in June last at about the time when the Ministry of Aircraft Production was formed ; this Committee was of much service to the Air Ministry, and many of the methods now used in air defence are due to its initiative. The Chemical Defence Committee, which continued for many years to advise the War Office and now the Ministry of Supply, has a number of independent members. The Civil Defence Research Committee has done valuable work for the Ministry of Home Security. The Ministry of Supply is well served by the Council for Scientific Research and Technical Development, formed early this year, the various committees of which have the right, and the duty, of inspecting and advising upon the scientific and technical work of the establishments of the Ministry.

The Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council are, of course, closely connected with the work of the Ministries of Agriculture, Health and Food, but they are responsible to the Privy Council, and their scientific councils have no direct means of ensuring that the best means for the fuller utilization of scientific and technical advice are adopted in these departments. The Fighting Services and other ministries are for the most part even less well served, so far as outside and independent critical opinion is concerned.

It is in this matter of providing opportunity for the voice of scientific men outside Government service to be heard in the deliberations of the various ministries, although not strictly within its terms of reference, that the newly appointed Scientific Advisory Committee may be able to perform a vital service. It is not a question of appointing a number of committees, ringing the changes for the several departments on the names of a few senior men of science, but rather of finding talent among the younger men, that their fresh minds may leaven those of the elders, and that their shoulders may early learn to bear the burden of responsibility.

In the conflict in which we are engaged, nothing short of the mobilization of the whole of the intellectual and material resources of the Empire will suffice. The contribution of science to the war effort should be a major one, for which the Scientific Advisory Committee may well be largely responsible. Moreover, the work must not cease with the end of the War. It does not follow that an organization which is satisfactory under the stress of modern warfare will serve equally well in times of peace ; but the principle of the immediate concern of science in formulating policy and in other ways exerting a direct and sufficient influence on the course of government is one to which we must hold fast. Science must seize the opportunity to show that it can lead mankind onward to a better form of society.

SOCIAL REHABILITATION

ONE of the consequences of the social disturbance and distress which have accompanied the widespread destruction of private property in the indiscriminate bombing attacks on London and other areas has been the realization that problems of social reconstruction have to be faced now and cannot be deferred until the end of hostilities is in sight. Whatever evacuation or shelter policy may now be adopted must be part of a long-term policy, keeping in mind the possibility of a long war, and designed to conserve morale and resources as effectively as possible. Short-sighted temporizing and timid palliatives are a public danger, and can no more be tolerated than the administrative incompetency from which they spring.

Recent events have made it plain beyond question that planning for social reconstruction must be undertaken in the midst of the War and as part of its effort with a vigour, a vision and a courage worthy alike of the gallant few on whom the main brunt of defence has fallen, the heroism of the civil defence services and the patient fortitude of those who have seen their homes and families shattered and scattered. The relief of distress in the stricken areas, evacuation of non-essential classes from the more dangerous districts no less than the restoration of public services which have been interrupted or dislocated, and other measures of social rehabilitation are tasks calling for immediate attention. None the less they should be handled not merely in respect of immediate and urgent needs but also in relation to the long-range problems of social rehabilitation and reconstruction which will confront us after the War.

The relief of distress and social reconstruction in the heavily bombed areas represent only one aspect of the question of social rehabilitation. The nation is equally committed to the care of its fighting men ; to see that when the War is over they may secure their places in civil life or find new places in which their energies can be employed. The care of the disabled soldier and of those suffering from cardiac, nervous and other afflictions is a particular aspect of such rehabilitation, and as to the value of this work the experience of the War of 1914–18 leaves no room for doubt. Equally that experience warns us of the danger of allowing what promised to become the foundation of a great national effort to dwindle to meagre or insignificant proportions. If justice is to be done to our fighting men, our gratitude to them to find adequate expression and even our pledges honoured, now is the time to look forward, to plan on an adequate scale and take such immediate steps as will prevent us again missing our goal.

If this is one of the main reasons for giving attention to such problems of social reconstruction at this hour, to ensure that the lines of an adequate policy and necessary measures and resources are available when the need for action arrives, so as to avoid the confusion and mistakes that are inevitable if we wait until such problems urgently arise, there is another equally as important. Our immediate problems and needs are related in a remarkable way to our long-range problems in this field, and attention to the latter requirements in dealing with the former may well assist to conserve our resources as well as facilitate reconstruction after the War. What is even more important is the contribution which such vision and long-range planning may make to public morale.

It is impossible to take a cross-section of opinion in Great Britain to-day without realizing the extent to which social reconstruction looms in the minds and thoughts of almost all sections of the community. The realization that the struggle is fundamentally between two entirely different social orders, between one in which the State is supreme and the individual is without rights and exists merely to serve the State, and one in which the State exists to serve those needs of individuals which must be met collectively in an ordered society, is widespread. Many indeed are coming to look for a new social order from which the grosser inequalities of wealth and opportunity have been eliminated and in which a finer tradition of public service is shared by all. If into such planning and reconstruction as are demanded now we could get something of this spirit and vision we might well give to those on whom have fallen the severest blows and heaviest strain just that inspiration and hope which count for most in maintaining morale and endurance under the War's sternest trials.

Such a possibility cannot be dismissed as impracticable or Utopian. We are apt, as Prof. J. H. Jones has pointed out, to exaggerate the real and enduring suffering caused by war and to assume the inevitability of poverty for long years after the War has come to an end. Such poverty is not inevitable if the resources of Nature, of technical skill and energy which will remain, with most of our capital resources are used with imagination and effectively organized. We have already indicated how reconstruction in the stricken areas, whether undertaken now or after the War, might be carried out in accordance with an adequate national plan and not marred again by limitations imposed by departmentalism, parochialism or vested interests. Similarly in the field of rehabilitation of the fighting men, as Dame Agnes Hunt has pointed out, there is real need for co-ordination in view of the many organizations concerned. Co-ordination, if it is to be effective, must stand above medical and vocational treatment and re-employment, with its corollary of a scale of pensions. Some rearrangement of existing responsibilities is necessary.

If the Ministry of Health, for example, acting through its Emergency Medical Service, assumed some of the duties now being discharged by the Ministry of Pensions and by the Board of Education, the ideal of a National Medical Service would be appreciably nearer realization. The Ministry of Health would thus become the sole authority of State on medical and surgical questions and would be in a position to lay down broad principles of procedure for the guidance of the secular ministries. Moreover, the work it is at present doing for disabled soldiers would thus become the basis not only of re-education but also of re-employment, and a beginning would have been made with the task of dealing with persons unable to perform heavy work or to work continuously.

The importance of this to industry is obvious, and equally its special value at the present time when our War effort demands the maximum utilization of man- and woman-power. The development of a National Medical Service in this way might well enable us to restore to industry without danger, not only many of the victims of tuberculosis as the work of the Papworth Village Settlement has shown, but also those of some cardiac and nervous and other chronic diseases if adequate steps were taken to secure their welfare. Even if such additions to our industrial resources were not effected in this way during the present War, we have here yet another striking example of the way in which far-sighted, long-range action is of benefit to our immediate purposes.

What must be kept particularly in mind is the importance of undertaking the requisite study of such problems now as a prelude to planning. For this reason alone the publication of Mr. D. M. Goodfellow's study of Tyneside (see p. 485 of this issue) is opportune. The social and industrial disturbances of war inevitably leave a legacy of problems. Areas of intense industrial activity in war-time are practically depressed areas in peace-time. Migration, whether of workers into centres of industry to increase production, or of workers and factories to less vulnerable and non-industrial parts of the country, are apt to involve distortion of development, lack of balance in productive capacity and of variety of occupation. The consequent problems to which attention in war-time is imperative even on the bare ground of production become even more acute when redistribution has to be faced after the War.

The Royal Commission on the Geographical Distribution of the Industrial Population in its recent report frankly faced a number of the problems of industrial dislocation at the end of the War, which indeed its recommendations are designed to mitigate. Mr. Goodfellow's report is concerned much more with social and welfare conditions, but equally emphatically he emphasizes the need for preparing plans for the transition well in advance and ready for application. Like the Barlow Commission, he stresses the need for co-ordination and for relating the measures of the Government, the local authorities and industry.

Social preparations must be planned and re-adjustments can no longer be left to chance. On that the investigations of Mr. Goodfellow and the members of his tutorial class organized by the Workers' Educational Association leave no room for doubt. They also trace the lowered vitality on Tyneside to-day back to a false prosperity which reached its apex during 1914–18 and weakened resistance in the long depression which followed. The scarcity of essential foods, and overcrowding and deficiencies in cleanliness and the normal care of children, partly through the absence of mothers working in the factories, played their part, and it needs little imagination to realize how serious a situation might well arise during the present War, let alone after it, even leaving out of account the disturbance and dislocation which heavy air attack may cause.

To some of these dangers the Government are already clearly alive, but one of the most significant features of the report is the fresh support it brings to the recommendations of the Royal Commission of Local Government in the Tyneside area. This acute piece of analysis emphasizes the erratic character of the Tyneside social services. They in no way correspond to the needs of the whole area. In many important services only Newcastle-upon-Tyne reaches the national standard. In others, some Tyneside towns make special efforts and rise far above that standard, while others fall far below it.

This inordinate disparity in the health and other social services on Tyneside is not always determined by poverty. Some of the poorest Tyneside towns make the best efforts to improve the conditions of their citizens, but do so only by taxing these citizens and so intensifying poverty. It is for this reason that Mr. Goodfellow sees danger in the formation of a region consisting of industrial Tyneside and Northumberland County as likely to lead to an over-emphasis of agricultural interests and continued disparities of social services. He recommends that Durham should be included from the first, if only because of Durham's excellent achievements in the development of social services, which indicate an attitude likely to be beneficial if not essential to the development of Tyneside.

Mr. Goodfellow suggests, however, that the division of local services into two types, regional and local, requires more consideration. In his view a regional authority for all purposes, controlling all services and strengthened by ownership of public utilities, would stand the best chance, without any danger of friction from minor authorities within its own boundary, of satisfying the conditions of the reports of the Barlow Commission. Such a regional authority would be able to speak with one voice as regards the industrial development and planning of the north-eastern region, its equitable treatment by the national exchequer, and the uniform development of its social services on the lines required by both industrial and agricultural districts. It might well also encourage the local development of the potential resources in leadership.

The value of this survey at the present time is unmistakable. It is a timely reminder that social welfare, the quality of the health and social services, cannot be let down at any time, even amid the desperate need of war, without the exaction of a heavy penalty later. Industrial and social policy must be brought together in a comprehensive welfare policy. Scientific workers will recognize Mr. Goodfellow's investigations as a sample of what might well be attempted elsewhere as a prelude to planning for social reconstruction. They should be grateful also for the stimulus it gives to the scientific consideration of the larger issues involved in regionalism. War-time developments have already opened up wider possibilities which might be utilized in the development of our plans for reconstruction after the War.

These possibilities cannot, even in the stress of war, be left purely to chance. Even now we must turn all available scientific energies to studying the causes of our difficulties. We cannot clearly prophesy to-day what form the society of the future will take, but as Mannheim has pointed out we need a new kind of foresight, a new technique for managing conflicts, together with a psychology, morality and plan of action in many ways completely different from those which have obtained in the past. It is only by re-making man himself that the reconstruction of society is possible. A conscious attack on the sources of maladjustment in the social order in this way, based on a thorough knowledge of the whole mechanism of society and the way in which it works, an attack on the strategic points and not the treatment of symptoms, might well yield results far beyond expectation and make some of the sacrifices of the War well worth while.

Scientific workers carry an inescapable responsibility for helping their fellow citizens to see and face these possibilities and responsibilities. They might well lend their support to such a central body as the Reconstruction Commission advocated by Prof. Jones, or sectional groups concerned with particular problems like the Architects National Council, which are attempting to study, collate and co-ordinate the changes that are occurring and the problems which emerge. Certain it is that if we are to see the health of the nation adequately safeguarded during and after the War and those whose lives have been disrupted, whether physically, mentally or spiritually by the impact of War, rehabilitated and established in a new social order, the planning and action must be based on fearless scientific investigation and courageous and far-sighted administration, untrammelled by departmentalism or prejudice.

AN ISLAND NATURALIST

Island Years

By Dr. F. Fraser Darling. Pp. xii+306+23 plates. (London: G. Bell and Sons, Ltd., 1940.) 12*s.* net.

IN "Island Years" we have an account, written most attractively, of a life which the author, along with his wife and his growing son, has lived (and still lives) on lonely Hebridean islands, uninhabited except by this little family.

The first island which Dr. Fraser Darling and his wife chose for their home was Eilean a' Chleirich, one of the Summer Isles, which lie off the coast of Wester Ross. Thence they migrated to Lunga, one of the Treshnish Isles, where they made a late autumn camp in order to study the habits of the Atlantic seal—and all the time the idea was taking shape of a more daring stay on Rona, a very lonely, storm-beset island lying 47 miles out to sea north-east of the Butt of Lewis. No one had hitherto thought of camping on Rona in the stormy late autumn season when the Atlantic seals in their thousands come ashore to drop their pups, but the Fraser Darlings braved a part of a winter there and faced gales so tremendous that those strong birds the greater black-backed gulls became quite exhausted and permitted themselves to be caught and lifted by human hands. Although the author does not say so, the photograph (illustrating p. 227) of Rona under snow to the water's edge depicts a very rare scene. I well remember the week in December in which the photograph was taken and never either before, or since, had I seen from my home in Skye the lesser isles of ocean snow-clad so completely.

Dr. Fraser Darling is a trained and observant naturalist. In his observations on the Atlantic seal he gives us much new and valuable data concerning the habits of these animals: his notes on that rare nocturnal bird, Leach's forked petrel, are also noteworthy. He mentions that he obtained a midnight flashlight photograph of this bird in flight: one could wish that it had been included in the illustrations, all of them excellent, of this book.

One learns with interest that the rock dove, numerous in Skye, does not nest on Rona; also that barnacle geese, which winter on almost all suitable Hebridean islands which are uninhabited, are absent from Rona.

There are so many interesting and delightful passages in the book that it is difficult to pick out the most attractive, but the account (p. 255) of the joy of the Atlantic seals as they battle with enormous seas is outstanding. Fraser Darling describes in restrained yet vivid language the occurrence (p. 262) of the 'green ray' at the moment of sunset at 10.10 p.m. after a day of restful beauty. I like, too, his description of Loch Fada (p. 50), and I am glad to see that he appreciates the aroma of the crowberry. This, to my mind, is one of the most fragrant and characteristic scents of the hills and moors, yet no other author I have read appears to have noticed it. On p. 48 Dr. Fraser Darling gives an interesting account of a peregrine falcon preying on little auks, and on p. 106, of barnacle geese alighting on the sea. I once saw this, from the same island group from which the author records it.

Writing of the eiders of the Summer Isles (p. 113), Dr. Fraser Darling mentions that their eggs hatch during the third and fourth weeks of June. Their laying must therefore be considerably later than the nesting season of the eiders of the mainland seaboard of the neighbouring county of Inverness where, on June 1 of the present year, I saw more than one brood of young eiders swimming actively in the shallow water of an ocean bay, accompanied by their parents. It is interesting, too, that the stormy petrels of the Summer Isles (p. 126) do not arrive at their nesting haunts until early June, whereas R. M. Lockley has chronicled that on the island of Skokholm (which lies off the coast of Wales) they first make their appearance as early as April. By the way, this species (p. 127) does not *always* "shuffle away on its hocks into its crevice" when disturbed, for I have on occasion seen them walk, upright and graceful. The statement that the legs "though of fair length, will not support the bird in the upright position of a robin or sparrow" is therefore not altogether accurate.

It is interesting to know that skylarks do not arrive at Dundonnell until April, because at my home in the north of Skye, where the species is abundant, they arrive with regularity in mid-February, regardless of the weather conditions then prevailing.

In this book unusual words are occasionally met with. "Cormorantry" as the name of a colony of nesting cormorants is new to me; so also is "rinze" heather.

"Island Years" is one of the best books of its kind that has been published, for the author has done things no other man has done, seen sights no other man has seen, and is master of a style so vivid that these rare sights and sounds are conveyed faithfully and without effort to the reader.

S. G.

WOODLANDS IN AGRICULTURE

The Management of Farm Woodlands
By Cedric H. Guise. (American Forestry Series.) Pp. x+352. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20*s*.

At the outset, farm woodlands are defined as areas of wooded growth that are integral parts of the lands used primarily for agriculture. As such they serve various useful purposes in affording protection to buildings and stock, in preventing undue soil erosion and, if skilfully managed, in providing profitable timber of various types. The problems of agriculture and forestry are inseparable in regions where the better soils are utilized for crop-growing and pastures, and woodland occupies the area of poorer quality. Detailed tables show how widespread these woodland areas are in the United States, the total value of the produce used and sold therefrom amounting to 190 million dollars per annum.

Good management of woodland entails the adherence to a definite policy based on sound technical forestry methods. Much improvement can be effected by judicious cutting, ranging from the provision of small wood for domestic purposes to the taking out of mature timber. In this, care is necessary to prevent injury to other trees from decreasing future profits. A management plan and simple book-keeping for each parcel of wood, combined with adequate selling arrangements form the basis of profitable woodland cultivation.

The volume under review is essentially a practical exposition of the knowledge and methods required to render the woodland a profitable section of the farm economy. The outline of woodland ecology describes the various types of growth, the light and temperature requirements of different species, and their susceptibility to diseases and pests, and provides lists of the most important trees associated with certain areas. A valuable section deals with methods of determining the volume, increment and yield of woodland products and the production of surveys and maps. Under the heading of protection the damage done to trees by grazing is emphasized, since usually a wood has little real value as a source of food for grazing animals, and both animals and woodland are likely to suffer.

Chapters on the utilization and marketing of woodland products, the durability and preservation treatment of wood and the general principles of management round off a book which should prove of great value to sylviculturists in all parts of the world. While the theme is woodlands in the United States, the text is of much wider application, and should be read with profit by all who are interested in the full utilization of all types of agricultural land. W. E. Brenchley.

COLOUR AND MUSIC

Colour Co-ordination
By M. Sargant-Florence. Pp. 352. (London: John Lane, The Bodley Head, Ltd., 1940.) 15*s*. net.

Many years ago, McDougall suggested that much confusion of thought on the subject of perception would have been avoided if all philosophers had been born blind. To this we might add that it would have been well if all colourists had been born deaf; and we might even begin to wish that Newton had never been born at all.

To such heresies are we driven by this book on colour co-ordination, which is devoted to establishing a theory of colour harmony by analogy to the theory of harmony in music, an idea which originated in the main from Newton. In his day, practically nothing was known of the mechanism of colour perception, and in the nature of things his suggestion could have been little more than a guess. The truth is that, even at the present day, our knowledge of the colour processes is so imperfect that it is quite impossible to say why some colours harmonize and others clash.

No one will grudge artists their attempt to establish an arbitrary system of colour harmony, although some of us may wonder why they should need it, and we may suspect that the greatest artists have done quite well without it. We would, however, admit that in teaching the less gifted among us, a system is useful, although its limitations may be dangerous. If we can assume that those with artistic leanings are likely to be conversant with musical theory, there is even something to be said for choosing music as the analogy. The real grievance of the man of science is different. What he must object to is the attempt to bolster up any analogy with pseudo-scientific ideas that must inevitably mislead those who have had no scientific training.

Newton's idea was based essentially on the comparison of the visible spectrum with an octave in music. The analogy has been fortified in detail by comparing the angles of refraction of different coloured rays through glass with the intervals in a musical octave. A glance at a modern glass list would immediately make one pause before trusting too much to a theory based on the dispersion of one particular glass. But there are in any event several difficulties about this octave business, not the least of which is that, as reported recently, young observers who have been operated on for cataract can see the near ultra-violet, and at a wave-length of 3,600 A. the colour is blue. On the octave theory, one would presumably expect it to be red. However, there is little scientific information in this book more recent than Newton's investigations ; there is certainly no mention of the hue discrimination curve nor of the locus of the spectrum colours in the colour triangle—two vital pieces of information in a discussion of this sort.

To overcome the difficulty that normally only one octave is visible, the author suggests that "the spectrum octave can be extended into a gamut of many octaves by definite manipulation in degrees of luminosity. [He appears to mean saturation.] But this extension does not find expression in terms of wave-vibration." Yet if the analogy is to find expression in any terms at all, wave-vibrations are the only possible terms.

As an instance of the misinterpretation of scientific data, the author refers to the fact that so-called monochromatic radiations may, when examined in an instrument of high chromatic resolving power, be found to break up into several components. He then concludes that the overlapping of these components may be responsible for the whiteness of different parts of the spectrum. Unfortunately, one cannot reasonably expect an artist to see the fallacy in an argument of this kind.

The trouble is that this book is symptomatic of the wide gap between the artistic and scientific approach to colour. Is it too much to hope that something may be done before long to bridge it ?

W. D. WRIGHT.

MUSICAL ACOUSTICS

The Musical Ear
By Ll. S. Lloyd. Pp. ix + 88 + 2 plates. (London, New York and Toronto : Oxford University Press, 1940.) 6*s*. 6*d*. net.

MR. LLOYD has done a public service by writing a book on musical acoustics which, while giving the latest results of scientific investigation, approaches the subject from the point of view of the musician. Too often the latter has had to complain of the attitude which many who write for him adopt ; that he ought to have taken a course in mathematics and physics at least up to university intermediate standard before reading their works, forgetting that, so overcrowded is the curriculum to-day that a knowledge of physical acoustics cannot be assured even to science students unless they have taken physics as one of the principal subjects of a degree course. It is true that it is impossible to write on sound nowadays without introducing concepts like frequency and phon or their equivalents, but Mr. Lloyd wisely does not confound his readers with an introductory chapter or appendix containing a long list of definitions. Instead he cleverly avoids defining many of the terms he has to employ, leaving the reader to sense their meaning from the context.

As for the contents, they form a series of essays on topics which embrace the relationships between physical acoustics, musical sounds and theory, and the ear—especially the ear. The author elaborates a point which the physicist and—more so—the musician is apt to overlook, namely, that the ear is, or should be, the final arbiter in sound experiments and that as an organ of response it has its limitations and idiosyncrasies. To the best of its ability it measures loudness, not intensity ; pitch, not frequency ; timbre, not overtone structure. In other words, a treatise on acoustics has a serious lacuna if it does not deal with the sensation of hearing. Pre-occupied with this aspect of music, the author is a little severe on Ellis who did, according to his lights, expound and amplify Helmholtz to the English reader. Mr. Lloyd also has an affection for mechanical rather than the more recent electrical methods of analysis and synthesis of musical sounds. In the essay entitled "Electronic Organs and the Phonodeik", the reader will find nothing about the former but a great deal about the latter. No one decries the importance of the pioneer work of Miller in this field, but the reader is not told that Miller had to apply a rather arbitrary calibration correction to his analyses with the phonodeik, a calibration which is largely avoided in modern electric wave analysers, by the possibility of omitting resonance cavities and bodies which were necessary in mechanical recording to produce the desired amplification.

A GREAT SWEDISH ASTRONOMER

Pehr Wilhelm Wargentin
Kungl. Vetenskapsakademiens Sekreterare och Astronom 1749–1783. Av N. V. E. Nordenmark. Pp. 464. (Uppsala: Almquist and Wiksells Boktryckeri A.-B., 1939.)

THOUGH Wargentin in his lifetime enjoyed a reputation which was both great and widespread—he was a foreign member of the Paris Academy of Sciences, of the Royal Society, of the St. Petersburg Academy and other similar bodies—he is probably little remembered outside his native land except by astronomers. Even in that circle he is known, perhaps exclusively, as an assiduous student of Jupiter's satellites in the days before Laplace investigated them as a dynamical system. In this voluminous memoir Wargentin is shown as a prominent figure in Swedish science in the great days of Linnæus and Scheele. In his versatility and by certain specific activities he is related to the Halley of the preceding generation. The memoir is in Swedish, but it includes (pp. 310–336) a résumé in French.

P. W. Wargentin was born in 1717, and as he died, like Euler, in 1783, he was an exact contemporary of d'Alembert. He was a student at Uppsala in 1737 when Celsius returned from abroad and resumed his chair of astronomy. As the subject of his thesis for the master's degree Celsius proposed the motion of Jupiter's satellites. At the time Jacques Cassini's new tables were expected to appear (1740), and the candidate was intended to include some discussion of them. As it fell out, the copy ordered from Paris was delayed in transit. Accordingly, Wargentin prepared fresh tables for himself, based on such observations as he could find. This was done with such success that the new predictions not only surpassed those given in the "Connaissance des Temps", based on the tables of the elder Cassini, but also those derived from the belated new tables of the younger Cassini. This was a real triumph, but it was followed by a catastrophe. On a journey to Stockholm at the end of 1741 the MS. of the tables was stolen from the coach, and Wargentin was faced with the task of repeating his work, which took two years to perform. But the reward was commensurate. At the age of thirty-one, Wargentin was elected corresponding member of the Paris Academy of Sciences, and member of the Swedish Academy of Sciences, and of the Uppsala Scientific Society, all within one year. The following year he was elected permanent secretary of the Swedish Academy, and thereafter until his death, a third of a century later, the story of his life is very largely the history of the Academy.

At that time the Academy was only ten years old; it will be recalled that its bicentenary fell last year. For two years it had enjoyed the monopoly from the sale of almanacs, but the revenue from this source was only modest, and it was charged with the erection of the Observatory at Stockholm. Under the management of Wargentin the yield from the monopoly was almost trebled within a couple of years. By this means progress with the Observatory, of which he was to be the first director, was advanced; it was inaugurated in 1753. Even while it was unfinished he had continued his observations, and afterwards he obtained the necessary funds to add a quadrant by Bird and other instruments to the equipment of the Observatory. Outside what must be considered his life-work on Jupiter's satellites, Wargentin's contributions to astronomy were chiefly in the field of parallax research. When Lacaille went to the Cape of Good Hope in 1750 to observe the moon and Mars, Wargentin made corresponding observations himself at Stockholm, and organized four other stations in Sweden. Similarly, he organized observations in addition to his own of the transit of Venus in 1761 and 1769. Thus his astronomical work was by no means confined to one special field.

But it was there that he made his reputation by his indefatigible researches. As a means of attack on the longitude problem, the eclipses of the Jovian satellites had attracted early attention. The first tables were made by J. D. Cassini (1668, revised 1693). Bradley's uncle, James Pound, published new tables in 1719, and Bradley himself contributed a new version to Halley's "Tabulæ astronomiæ" in 1749. So it would appear from this passage (pp. 327–328): "Sans doute Halley publia-t-il dans ses Tabulæ astronomiæ de 1749 des tables remaniées par Bradley et dues plutôt à son oncle Pound. Halley n' avait naturellement pas encore connaissance, à cette époque, des tables de Wargentin qui se montrèrent bientôt supérieures à celles de Bradley." But this cannot be accepted as fair comment, for the simple reason, of course, that Halley died in 1742. In fact, Bradley's "Corrected Tables", which were published as stated in 1749, were finished in 1718, when he was barely twenty-five and was serving that apprenticeship with Pound during which it would be probably hard to distinguish clearly between the work of uncle and nephew. It may be surprising that these obsolete tables were included in the 1749 edition of Halley's collection, but it was most natural that ten years later Lalande substituted Wargentin's revised tables in his Paris edition of the same collection. The observations were continued, and the tables were revised from time to time until they reached a state of perfection which was truly admirable. For they were scarcely surpassed, as de Sitter ascertained, by Delambre's tables of 1792, which were founded on the dynamical theory of Laplace, whereas the earlier method had been purely empirical. This process has been compared with Kepler's, but a closer analogy may be seen in the lunar theory of Horrocks, and Wargentin's success in isolating the main inequalities in the motions of the satellites was quite remarkable. As this work has met with the fullest recognition it was scarcely necessary to dispute (pp. 205, 327) Bradley's priority in noting the commensurable relation connecting the mean motions of the three inner satellites. Wargentin was fortunate in finding a task in astronomy exactly suited to his powers, and he carried it out admirably.

To this account of his astronomical work it should be added that besides the observations made on every possible night he initiated a routine of meteorological readings by day, the beginning of a continuous record to the present time. No assistant is mentioned, and he seems to have worked single-handed throughout.

But Wargentin the astronomer was only half the man, whose capacity for work must have been prodigious. As secretary of the Swedish Academy, then in its infancy, he developed all the activities which can be expected from a national academy. In general such duties devolve on a considerable number of individuals, but Wargentin combined them in his own person. He was secretary, editor of the publications, treasurer, foreign secretary and librarian all in one. In no respect did the interests of the Academy suffer from this concentration of functions ; on the contrary, it prospered in all departments. His success in nursing the revenue from the sale of almanacs has already been mentioned. He cultivated foreign correspondence with special ardour in addition to the domestic exchange of letters. As a result the Academy possesses more than 4,000 letters addressed to Wargentin, and it may be interesting to select a few names : Jean Bernoulli (40), A. v. Haller (45), Max. Hell (15), Lacaille (10), Lalande (38), Lexell (111), Linné (124), de l'Isle (20), Maskelyne (5). There is even a letter from Marat, dated 1779. Apart from this, the sample selected naturally reflects in the first place Wargentin's high position in the astronomical world.

The functions of a national academy are not confined, however, to its own affairs or to its foreign relations. It has many opportunities to offer advice to Government in the interests of the country, and such advice often involves great labour. When the Gregorian calendar was introduced in 1753 Wargentin played an effective part in recommending the change. This was appropriate to his professional character. More remote was an active share in the commission directing work on the Trollhättan Canal. Still farther afield was service on a commission to translate the Bible, where his special concern was with biblical chronology. But Wargentin had enjoyed the advantages of a wide liberal education in his youth. He could turn a set of Latin verses, though whether they would have satisfied the critical taste of Bentley better than Halley's may be doubted.

In 1769 Wargentin received the royal commission to construct a map of the Swedish coast. The work was unlike Halley's on the English Channel in the *Paramour Pink* because the observations had already been made. In this case the task proved too much for an overburdened man and it was relinquished within two years in an unfinished state. But one interest persisted through life and constitutes a second high claim to recognition. So early as 1736 the Swedish Government was taking an interest in vital statistics. This was fostered by the Academy and the new secretary soon took a leading part on an expert committee appointed by Government. The outcome of Wargentin's researches and reports was the creation of a permanent organization in 1756 which is said to have been the first of its kind in the world. From the data collected in the following years he formed tables of mortality which marked a great advance no doubt on previous knowledge, though the claim that they were the first to be based on exact data rather overlooks the "Breslau Tables" of Halley. The Swedish results met with the warmest reception from Richard Price, whose opinion of them may be quoted : "These observations are more curious than any that have been yet published, and leave us little to wish for on this subject, except that similar observations were made in other kingdoms under direction of men equally able and ingenious with Mr. Wargentin". Through Price they must have exercised an influence on British actuarial practice. In Scandinavian countries Wargentin laid a foundation the effect of which is still visible in the theory and applications of statistical science, so keenly cultivated in that region of Europe.

The author of the present memoir has drawn the portrait of his subject perhaps a little larger than life-size. With every discount, a very considerable figure emerges who was not only eminent in his own small country—according to his own estimate the population of Sweden was little more than 2·3 millions—but also a man of real distinction in the larger world of eighteenth-century science.

H. C. Plummer.

RECONSTRUCTION AND TOWN AND COUNTRY PLANNING

THE widespread destruction of property in the Greater London area which has attended the air raids of recent weeks should have brought home to everyone both the need and the opportunity for reconstruction which have come. The appointment of Sir John Reith, who is being made a baron, to the new office of Minister of Works and Buildings and First Commissioner of Works, suggests that the Government recognizes officially the magnitude of the task which lies ahead. So long ago as November 1939 an admirable paper by W. Braxton Sinclair on A.R.P. in town planning before the Air Raid Protection Institute indicated some of the possibilities in this direction if realistic and rational planning receives the executive authority to ensure that the plans are given appropriate effect.

The reconsideration of the planning of London in the light of civil defence is, however, only one point of view which needs attention before reconstruction is undertaken. Other important factors were indicated in the P E P (Political and Economic Planning) report on the location of industry and have since been reiterated in the report of the Royal Commission on the Geographical Distribution of the Industrial Population. Attention has recently been directed to the importance of this report by Lord Balfour of Burleigh, chairman of the 1940 Council, appointed by a conference of the Royal Institute of British Architects in February of this year for the promotion of the planning of social environment.

The conference in question was called to consider what immediate action could be taken to promote, through research groups or by other means, the planning of social environment on a national scale and to make more widely known the need for such planning. The work of the Council thus involves both research and publicity, and its activity in each field will be largely dependent on interested societies, the co-operation of which will be sought in their special fields of work. Lord Balfour has emphasized the way in which planning for post-War conditions must start from the recommendations of the Report of the Barlow Commission, and has also indicated the Council's general agreement with nine agreed points of principle reached by the Royal Commission. Beyond this, however, the Council recommends further investigations in a number of directions, particularly as there appears to be no immediate prospect of the proposed national board being established.

Among these new directions for investigation as a prelude to reconstruction are the problems raised by evacuation and the dispersal of industry, through the development in rural areas and elsewhere of immense war industries and undertakings. There are also the problems already mentioned arising from the destruction of buildings by aerial bombardment, and those of planning for demobilization so as to have ready for immediate operation a long-term constructive programme to bring hope and inspiration to a war-weary people, millions of whom will see their war occupations coming to an end. Lord Balfour rightly suggests that such problems may well call for a different type of national board from that envisaged by the Royal Commission, and that in view of the extent to which the winning of the War demands almost the entire attention of the Government, the preliminary research and thought should be devoted to these problems by a voluntary body such as the 1940 Council.

There is ample evidence that Lord Balfour of Burleigh's initiative is not premature, even if we are at the height of a life-and-death struggle. Valuable, however, as the efforts of an unofficial body may be, there are several reasons for doubting whether anything short of an official body will be adequate even for the preliminary work. For one thing, apart from the fairly considerable amount of research that will be required, the whole course of the War demonstrates the difficulty of predicting its termination with any exactitude. The fundamental lines of our planning can scarcely be determined too early if they are to be ready against an unexpectedly early termination of hostilities, the demands of which are likely to be no less searching than at the end of a prolonged struggle. Moreover, as the War proceeds, the problems in which immediate action affecting post-War policy and planning are imperative multiply. Not only does it frequently happen that the wisest immediate policy is that in line with long-range requirements of reconstruction, but also in the absence of such foresight fresh obstacles may be created or allowed to grow up in the way of the planning required on a national scale after the War.

The whole experience of the War of 1914–18 goes to show indeed that planning for reconstruction during a war is essential. The Ministry of Reconstruction which was created in August 1917 was actually the successor of a Reconstruction Committee appointed much earlier by Mr. Asquith when still Prime Minister. The great value of the plans prepared by the Ministry before the Armistice is often obscured by the difficulties which appeared in 1920. Much social legislation of which we are now justly proud was embodied in those plans. While other projects encountered heavy weather either temporarily or permanently, it is quite clear that but for the work of the Ministry of Reconstruction our post-war troubles of 1919 onward would have been even more serious. So far from the formation of the Ministry being premature the evidence is rather that it was not initiated early enough for all the complex problems involved to be investigated adequately before it was necessary to formulate policy and take action.

The scope of the work and duties of the Ministry of Reconstruction as conceived after some six months work are well worth recalling at the present time. A statement issued to the Press for a meeting on January 24, 1918, indicates that the Ministry embraced branches dealing with commerce and production, including the supply of materials; with finance, shipping and common service; with labour and industrial organization; with rural development; with the machinery of Government, central and local, including health and education; and with housing and internal transport. The Ministry as a whole and the several branches in particular were concerned with the study of all proposals for dealing with post-War problems, whether under consideration by Government departments or committees or advanced by responsible bodies or persons, and with the development out of this material of a reasoned policy of reconstruction in all its branches. An advisory council, representative of all the leading interests concerned, had already been created by the Minister, organized in four sections on similar lines, and the statement indicates that in certain fields inquiry had already reached a surprisingly advanced stage.

Much of the work which was done then is clearly available for our guidance in the situation confronting us to-day, but whether or not the many investigations which are still required are prosecuted under private or Government auspices, the importance of some co-ordinating Government department charged with the prime responsibility for reconstruction can scarcely be denied. Already the difficulties in regard to relief accommodation and transport, the provision of shelters and the organization of evacuation of non-essential classes from threatened areas have indicated the need for some single supreme authority to deal with these problems in respect of London alone. Such an authority is needed partly to prevent confusion through divided responsibility or inadequate local resources in individual boroughs. Much more, however, the need is for inspiration and leadership and the power to cut through any network of 'red tape' or private interest that may stand in the way of swift emergency provision for the homeless or distressed, or the organization of shelters and transport services so as to secure the maximum possibility of sleep for London's workers.

If a leader of the right type could be found for such a post and given the sweeping powers essential, he could give new spirit and purpose to the whole work and quickly win the eager co-operation of the public. Nor should the effect be confined merely to relief of the immediate strain that the people of London are enduring. The disappearance of difficulties that at present seem formidable in the immediate situation would be of immense value also in dealing with reconstruction after the War, and leadership of the type visualized would supply exactly the right drive and direction required in the approach to problems of reconstruction during the War.

What seems to emerge from a review of the work and achievements of the former Ministry of Reconstruction is first that the educational work in preparation for reconstruction was insufficiently thorough and widespread, and secondly, that without disparaging the vision displayed by the Ministry, the importance of co-ordination and the extent to which problems of reconstruction are interlocked was not sufficiently realized. The first of these functions is one that the 1940 Council has undertaken to serve, but the second is undoubtedly one for the Government itself. Moreover, it cannot be expected that all the fundamental research which is required as a basis for planning can wisely be left to individual initiative. Government support and direction are required if only to see that resources are allocated to such effort as part of our national War effort, and in due proportion with other demands.

It is true, of course, that in some directions research is already proceeding under Government auspices, for example, under the Building Research Board, which is of direct importance to post-War planning although inspired by immediate requirements. Much more is possible in this way if only we are awake to our opportunities. For example, it has been pointed out how in the planning of a new city the incorporation of an appropriate green belt can be made to fulfil a military need to enclose and limit the city boundaries and provide dual encircling road communications with ample scope for the provision of aerodromes, anti-aircraft gun positions, searchlight stations and the like, and also accord with the principles of good civil planning. Similarly, in the provision of perfect road communications the military requirements coincide in the main with the civil needs of the population.

While it is true that in town planning, as well as in regard to building, we need principles which have been reached as a result of scientific research, it should not be forgotten that in particular scientific fields a firm scientific basis is already available as a basis for policy. What is required in the matter of sunlight incidence, for example, as pointed out by Mr. Thomas Sharp in his excellent little volume on "Town Planning" in the Pelican series, is appropriate action on the facts already ascertained. The most disturbing feature of the whole situation is indeed just the shelving by the Government of the Report of the Barlow Commission.

It cannot be too strongly insisted that unless the long-term problems involved in the location of industry, evacuation, and national defence are faced now, formidable and perhaps unsurmountable obstacles may be placed in the way of the scientific use of our resources and of post-War reconstruction. Town and country planning have acquired a new importance, and the formulation of a national policy is imperative.

For this reason alone Mr. Sharp's little book deserves widespread attention. It is not merely that he directs attention to the dangers attending a policy of drift or to the essential unity of town and country planning. He stresses the need for a clearly thought out and well-defined policy, but the greatest value of his book may well lie in the revelation it will bring to many of the opportunities which clear vision and determined policy can put within our reach.

It is indeed important to remember those opportunities in view of the triviality and narrowness of some of the aims of our statutory town and country planning, its inadequacy or ineffectiveness, particularly on the larger issues, in face of the rights of private property, and the inadequacy of the agents to which such planning has hitherto been entrusted. It should be remembered, moreover, that the English contribution to the art of building towns was once an original and a valuable one, while its achievement in the countryside in the eighteenth century, as Mr. Sharp points out, was one of the most successful creations of its kind in the contemporary world.

The knowledge of the way in which the opportunities for improvement which changing conditions offered was taken by our eighteenth century forefathers should be an inspiration to us amid the even greater opportunities of to-day. If we vigorously seize them, snatching from them every possibility of doing our work in the finest instead of the easiest way, we may not only find new forms of expression worthy of the new materials and new powers with which science and technical advance have endowed us, but also, in so doing, once again build towns that will be worthy of us, possessing beauty and order and all the facilities for the living of that good social and physical life which it is the prime purpose of the town to provide.

Simultaneously, the opportunities in the countryside must be recognized and used. The preservation of the countryside must be recognized as a dynamic, not a static, ideal. The countryside is not merely scenery; it is a place of industry as much as is the town, a place of social and economic activity. It is a living organism to preserve which is merely to kill it.

No less in the countryside than in the town, we can if we will use the opportunities of social and economic change for the creation of new beauties and new possibilities of happiness. Already the problems encountered in evacuation have indeed shown how much might yet be done to make an even finer countryside in which, beside the harmony of all its constituents in a sympathetic relationship to each other, making a splendid whole which was the feature of the past, we have among those constituents the facilities necessary to enable the great new inventions to confer their immense benefits upon the countryside as well as on the town. Besides this, the exploration of agricultural policy in regard to food supply and health may well lead to new lines of development, to changes in the use of the land which have to be integrated into a national rather than a departmental policy if we are to reap their full benefits.

It is well that the opportunities which are before us should be so clearly indicated, and the extent to which we can, if we will, seize them while still prosecuting our War effort with all the energy at our command. Our environment will be modified by new forms of knowledge as well as by the demands of national defence or the consequences of enemy action, whether we consciously use that new knowledge in planning or not. The full advantages of social and economic reconstruction can only be secured if we embark now on the necessary planning and the investigations on which such planning must be based. If we attempt at once to take full account of the impact upon town and country planning and social conditions of the revolution in means of communication, and so plan the utilization of our resources for national defence that post-War reconstruction is kept clearly in mind, it should be possible to avoid many sacrifices of the requirements of peaceful living, to promote that educational process which must precede social reconstruction and to foster much of the scientific research which will supply the basic data alike for the purposes of total war and for the reconstruction to follow.

THE PROGRESS OF CAMOUFLAGE

In Nature of June 22, there appeared a leading article in which the camouflage organizations of Great Britain were severely criticized for not making sufficient use of scientific men and scientific principles.

As evidence of the way in which the scientific spirit is, however tardily, coming into its own in the conduct of the war, the following impressions of a visit to the headquarters of the Civil Defence Camouflage Organization may be of interest.

This is the largest central organization devoted to camouflage, and forms part of the Research and Experiments Department of the Ministry of Home Security, to whom Dr. R. E. Stradling is the chief adviser. The experimental work is under the direct supervision of Prof. W. E. Curtis, assisted by a technical staff which includes artists, engineers, architects, chemists, physicists, photographers, and a botanist. All the work is studied as an air problem. The sites and buildings to be camouflaged are first viewed and photographed from the air. If they are of major importance, a model is then made and camouflage applied to it. It is inspected in a special viewing room, where a turntable and a movable light provide varied conditions of illumination; and also out-of-doors from a greater distance. After the model has been, if necessary, corrected, and a colour photograph taken of it, the camouflage scheme is then applied to the actual site, which is then again viewed and photographed, this time in colour, from the air; and any final corrections required are then made. In the case of smaller buildings or those which offer less difficult problems, the model is dispensed with, and its place is taken by a two-dimensional sketch of the camouflage scheme.

One of the criticisms made in the earlier article was that biological principles were being largely disregarded. This certainly does not apply to the present work of the Civil Defence Camouflage Organization. What the biologist calls general resemblance, special resemblance, disruptive pattern, deflection, and mimicry are all now being employed as the situation dictates.

General resemblance is more commonly employed in military camouflage in the field, where mobile objects are coloured so as to be as inconspicuous as possible against a variety of surroundings. Special resemblance to particular natural objects is often extremely ingenious. Admirable methods of counterfeiting grass are now available, and artificial woods with 'sapless foliage' but permanent greenery spring up where required. Sham buildings, worthy of a film set, may be used to disguise landmarks.

In biological mimicry of the typical or Batesian kind, a harmless organism evolves so as to counterfeit the appearance of one better protected against enemies than itself. The reverse is true in mimetic camouflage: an object of military importance, such as an armaments factory, is disguised to resemble a non-military objective. Some of these schemes are most successful.

In biological deflection, the attack of an enemy is drawn away by conspicuous pattern from a more vital to a less vital part of the body, or from a biologically more important individual (such as a brooding duck) to a less important one (such as the drake, the racial function of which is over for the year once he has fertilized the eggs). In a similar way, false targets may be employed in war to draw attack away from real ones: without giving away vital secrets, it may be said that some of the deflection methods now employed are both ingenious and effective.

Disruptive pattern, however, when all is said and done, is the most essential tool of camouflage for large stationary objects such as buildings; and this is now being employed to extraordinarily good effect. One of the earlier criticisms was that the pattern used was on too small a scale to be effective against air attack, but this no longer holds, and remarkable illusions are produced.

Another criticism made in the earlier article was that structural methods were being neglected, and undue reliance placed on paint, which by itself is often helpless to disguise shadows and hard outlines. This was true to some extent during the early months of the War, but to-day (though not until after a struggle) various structural devices are being utilized on a large scale, and a special engineering section has been formed in the camouflage establishment to deal with the unfamiliar and troublesome problems involved in their proper use.

Yet another criticism was that the work was entrusted too exclusively to artists. The experience of the Civil Defence Camouflage Station is that artists are indispensable for design, both because of their gifts of observation and for their capacity to see and memorize a site in terms of colours and tones instead of in terms of objects of human significance, and also because of their technical knowledge as executants. But their work is carried out under the supervision of the physicist in charge, so that art is constantly guided and checked by science.

It must not, however, be supposed that perfection, scientific or otherwise, yet reigns in the camouflage world. In the first place, the Civil Defence Station is only one, albeit the largest, of the various organizations dealing with the problem. In addition, there is a large amount of private property not regarded as of sufficient importance to justify official action. In practice, however, owners of such property are consulting the Station in increasing numbers, with the result that there will be fewer unscientific monstrosities such as the cooling cylinders, mentioned in Nature of June 22, the white surface of which was adorned with naturalistic trees.

Not all the different organizations are as yet equally scientific or efficient, and in some cases, notably ships at sea, far too much use has been made of the anti-scientific principle of uniformity of colour and tone, which gives the most conspicuous possible pattern.

In addition it would appear that in some quarters camouflage has become a sort of fetish, implying the application of green and brown blotches of one or two feet in diameter, whatever the object to be disguised and whatever its surroundings. But here, too, the situation is improving.

Then, as may be imagined, co-ordination and central direction are difficult so long as we have numerous separate organizations which, starting independently, tend to preserve their independence. Something, however, has been done to remedy this, by means of a new co-ordinating committee, attached to the Civil Defence Camouflage Station, but containing representatives of other organizations, both official and non-official.

But the most important enemy of efficiency has been delay—delay between the completion of a scheme and the beginning of the application of paint to the actual building, delay which may involve several wasted months. In part this would appear to have been due to official regulations and methods of working, in part to carelessness or inefficiency on the part of the private firms the buildings of which are being camouflaged, or of the firms undertaking the actual camouflage.

Another trouble is the habit of regarding camouflage as something you put on to a building when it is completed. The notion that it would be much easier and cheaper, and much more likely to achieve really good disguise, if buildings were designed from the outset in relation to the problem of their camouflage, has scarcely entered the mind of authority or of builders. Buildings of the utmost regularity, and therefore extremely difficult to disguise, still continue to be erected, simply because that is the recognized pattern for buildings for that particular purpose.

Photographs of one of the few buildings which has been designed from the outset in co-operation with camouflage experts make one realize what could be achieved. The huge structure is part of the English landscape, complete with fields, woods, roads and hedges, and is as nearly indistinguishable as could be imagined.

The camouflage services inevitably suffer from the high cost of many of their schemes, the shortage of supplies, and the fact that camouflage is low on the list of priorities. It is clear, however, that in spite of a slow start, the art of camouflage has in the last six months gone far in utilizing scientific knowledge and scientific methods.

J. S. H.

OBITUARIES

Sir Harold Carpenter, F.R.S.

Sir (Henry Cort) Harold Carpenter, professor of metallurgy in the Royal School of Mines, London, whose death at the age of sixty-five occurred on September 13, was regarded as the leader of the metallurgical profession in Great Britain. He came from a family which produced several distinguished men, and in view of his career it is particularly interesting that one of his great-great-grandfathers was Henry Cort, whose inventions did so much to establish the position of England at the head of the iron industry in the eighteenth and nineteenth centuries. Carpenter, however, was not originally trained as a metallurgist. He studied chemistry at Oxford and Leipzig, and became research fellow and demonstrator in Owens College, Manchester.

When the National Physical Laboratory was established in 1902, Carpenter was appointed to take charge of chemical and metallurgical work. The choice was fully justified by the production, in a very short time, of several important researches, the chief of which was the determination, with B. F. E. Keeling, of the range of solidification and the critical ranges of the iron-carbon alloys. Although much work has since been done on this system, the latest determination confirms the essential accuracy of their results, other investigators having been less successful in obtaining equilibrium. The aluminium-copper system was examined with similar minute accuracy, while other papers dealt with the heat treatment of high-speed tool steels and with complex alloys of iron—a remarkable output for the early days of a new institution with very limited staff and equipment.

In 1906 Carpenter was appointed to the chair of metallurgy in the Victoria University of Manchester, and in 1914 he moved to the Royal School of Mines, after a tour of metallurgical centres in the United States with the object of seeing industrial smelting processes at first hand. Under his guidance both these laboratories became active centres of research. Besides the determination of the equilibrium diagrams of binary and ternary alloy systems, and studies of the growth of cast iron, his work dealt largely with the growth of metallic crystals after mechanical strain. In this way, as the result of a series of well-planned experiments, he was led to the study of single crystals, and this new method of preparation proved to have many advantages over that of solidification from the melt. Partly with collaborators, he undertook a thorough examination of the modes of deformation of single crystals, and thus opened up a new and very important field of research. His interest in the processes by which metallic structures are formed was further shown by a series of papers in which the mode of separation of ferrite and pearlite from austenite in steels was studied in detail, and by an investigation, illustrated by beautiful photo-micrographs, of the structures of native copper and silver.

Carpenter was an admirable teacher. He had the faculty of interesting his students, who always held him in the greatest respect and affection. His courteous manner and wide interests made him an excellent chairman, an office which he held in the Metallurgy Research Board and the Gas Cylinders Committee, among other bodies. He had the unique distinction of having occupied the presidential chair of all three of the institutes connected with his science: the Iron and Steel Institute, the Institute of Metals and the Institution of Mining and Metallurgy. To all of these he gave devoted service. When, in 1929, the Treasury set up a committee to inquire into the position of scientific staffs in Government departments, he was appointed chairman, and the "Carpenter Report", with its far-reaching recommendations, has served as the charter of the scientific side of the Civil Service. The tact of its chairman had much to do with its success. In later years his services were more and more called upon as an adviser on matters of scientific administration.

When war broke out in September last, the Metallurgy Department of the Royal School of Mines was transferred to Swansea, where professor and students found a congenial home with Sir Harold's former assistant and collaborator, Principal C. A. Edwards. Shortly before, with Dr. J. M. Robertson, he had completed a book which had been long in preparation, and forms an enduring monument of his work. This two-volume treatise on "Metals" covers an extraordinarily wide range, from crystal structure to industrial processes. In spite of its size, it has nothing of the encyclopædia in its character, but is a clear and most readable survey of the field of metallurgy, accurate in detail but never allowing the main lines to be obscured. Only the unavoidably high cost of so large a book prevents its more extensive use by students.

Many honours came to him. He was elected fellow of the Royal Society in 1918 and knighted in 1929. He received honorary degrees from the Universities of Wales and Sheffield and was a corresponding member of the Royal Swedish Academy of Science and of the Société d'Encouragement, and an honorary member of the American Institute of Mining and Metallurgical Engineers. He was awarded both the Bessemer and Carnegie Gold Medals of the Iron and Steel Institute, the Institution of Mining and Metallurgy and the Thomas Turner Gold Medals, the Carl Lueg Gold Medal of the Verein deutscher Eisenhüttenleute, the Platinum Medal of the Institute of Metals and, only this year, the Honda Gold Medal of the Japanese Institute of Metals.

Lady Carpenter, formerly Miss Ethel Lomas, was his devoted and constant companion, and in acknowledging the award of the Bessemer Medal, he paid tribute to her constant support and aid in his work. Mr. Headlam-Morley's account of him in *The Times* of September 26 gives a striking picture of the impression which his personality and character made on his many friends. He was a lover of walking and of the mountains, and had seemed to be well in health, but although there were no external signs of arterial disease it was well advanced and his death from heart failure occurred while on a country walk near Swansea.

C. H. DESCH.

Mr. F. Hutchinson

IN the death on April 6 of Francis Hutchinson, New Zealand loses one more member of that distinguished band of naturalists who were the forerunners of present-day scientific research in that country. He lived during the period which saw the transition from the pioneering work of Colenso, Haast, Hochstetter and others to the present age of specialists and research laboratories, and like his friend Guthrie-Smith (whose death was recently recorded in NATURE) most of his studies were made in the field.

Hutchinson was for some years editor of the *East Coast Naturalist*, a pioneer journal conducted in manuscript, and occupying a unique place in the scientific literature of New Zealand. He also contributed occasionally to the *Transactions of the New Zealand Institute*. He will, however, be chiefly remembered for the moulding influence he exerted on many of the present-day generation of research workers of his country; he had a genius for expressing the facts of Nature in language calculated to stimulate the imagination of the boy, and the number of younger scientific workers who owe their first teaching to him is itself a tribute to his memory.

A few years ago Hutchinson presented to the nation a tract of virgin forest at the foot of the Birch Mountains for preservation as a scientific reserve. Mrs. Hutchinson, who survives him, was his companion on many naturalist expeditions in the mountains of Hawkes Bay, and is at present engaged on a study of the lichen dyes of New Zealand.

H. BARRACLOUGH FELL.

NEWS AND VIEWS

Science and the National War Effort

In order to ensure the continuance of the fullest co-operation of scientific workers with the Government in the national war effort, the Lord President of the Council, after discussion with the Royal Society, has, with the approval of the Prime Minister, appointed a Scientific Advisory Committee with a secretary from the Cabinet Secretariat. The terms of reference of the committee are: (*a*) to advise the Lord President on any scientific problem referred to them; (*b*) to advise Government departments, when so requested, on the selection of individuals for particular lines of scientific inquiry or for membership of committees on which men of science are required; (*c*) to bring to the notice of the Lord President promising new scientific or technical developments which may be of importance to the war effort.

The members of the committee are: Lord Hankey, G.C.B., G.C.M.G., G.C.V.O., chancellor of the Duchy of Lancaster (chairman); Sir William Bragg, O.M., K.B.E., president of the Royal Society; Dr. E. V. Appleton, F.R.S., secretary of the Department of Scientific and Industrial Research; Sir Edward Mellanby, K.C.B., F.R.S., secretary of the Medical Research Council; Sir Edwin Butler, C.M.G., F.R.S., secretary of the Agricultural Research Council; Prof. A. V. Hill, O.B.E., F.R.S., M.P., secretary and Foulerton research professor of the Royal Society; Prof. A. C. G. Egerton, F.R.S., secretary of the Royal Society and professor of chemical technology in the Imperial College of Science and Technology.

Social Survey of Tyneside

In "Tyneside: the Social Facts" (Newcastle-upon-Tyne: Co-operative Printing Society, Ltd., 1940. 1*s*.) Mr. D. M. Goodfellow gives the results of a session's work of a tutorial class organized by the Workers' Educational Association in Newcastle-upon-Tyne, which shows the effects of the depression in Tyneside. A short summary is given of the death-rates from tuberculosis, pulmonary and non-pulmonary, in the Tyneside area which shows that the Tyneside districts in 1917 showed increases for the most part much greater than in corresponding districts throughout the country, while by 1921–25, the reduction in the incidence of tuberculosis was far less than in the whole country, except for one town; although the position improved by 1935–37, the improvement was appreciably less than in England and Wales as a whole. These high tuberculosis rates, in spite of a relatively high standard of public health services, much superior to that of the Welsh areas, is attributed to the effects of a false prosperity which reached its apex during the War of 1914–18 and weakened Tyneside's resistance in the long depression that followed, overcrowding and large families rendering the area specially vulnerable.

Children and Poverty

Mr. Goodfellow accordingly points out that sanatorium treatment of tuberculosis must be followed by real enterprise to remove the poverty of the patient. Infant mortality figures confirm this effect of the last war on Tyneside. In 1911–13, Newcastle, Tynemouth, South Shields and Gateshead were all below the infant mortality average for English county boroughs. By 1914–16, as a result of increased industrial effort without proper safeguards, these four Tyneside boroughs had infant mortality rates much higher than English county boroughs as a whole and while from 1911–13 to 1935–37 in the country as a whole infant mortality was reduced by practically 50 per cent, the Tyne black spots showed no such improvement. These figures again are related to overcrowding. In 1925, one baby in three in Tynemouth was born in a one-room apartment, and even in 1933 one baby in five suffered this fate although in 1938 the rate had fallen to one in 20. The figures are again related to the work of infant welfare centres. In Leeds, for example, with an infant mortality rate of 64 per 1,000 births, the rate fell to 21 among babies attending the clinics.

Mr. Goodfellow's review of the maternity and child welfare centres on Tyneside shows the variation in the provision for such services made in very similar areas and emphasizes the need for radical reorganization of local government services taking account of the needs of all types of district. Similar variations or discrepancies occur in the school medical services, in the provision of school meals, milk, or for defective children. During the past few years Tyneside and Durham have fallen further behind other districts in regard to malnutrition of school children, even by present methods of assessment the percentage of under-nourished children being more than three times as high in Tyneside and Durham as it is in London and the south. Equally wide variations occur in the Tyneside districts in regard to the percentage of elementary school children leaving school at the age of 15 or over, although it should be noted that in five years Tyneside has lost more than 15 per cent of its elementary school children.

Civic Authority and Social Development

The local rates show the same wide fluctuation, and Mr. Goodfellow points out that if civic conscience is to be developed, Newcastle, Gosforth and Whitley Bay and Monkseaton must enter a unified Tyneside and give it the benefit of their rateable value. The attitude of mind which has allowed business people to reside in Gosforth on profits made out of Jarrow or Felling or Hebburn, while disowning all responsibility for even the barest minimum of decent existence in Jarrow, Felling or Hebburn is utterly inconsistent with civic decency. Mr. Goodfellow considers that the new region should also include Durham, partly to avoid Tyneside, as an industrial region, being swamped by a conservative and agricultural county, which has not yet shown itself to possess industrial standards in its social services, and partly because of Durham's achievements in the development of such services, and he also points out the example set by some of the districts such as Felling in changing their character from a slum-ridden overcrowded little town to one of the best garden cities in the country. If such districts lose control of their own civic life the division of powers between local and regional authorities will require the closest consideration to avoid friction or deadlock, and Mr. Goodfellow advocates the transfer of control of all services and ownership of all public utilities to the regional authority as most conducive to social development.

Conflicting Ideals and War Aims

On the outbreak of war, the -ologies and -isms into which the world of European civilization had been divided since the irruption of the dictator into national and international politics were resolved into an opposition of Christianity over against paganism. Such at least has been the rallying cry with which Britain, in what may be termed her official proclamations, asks for and has received the moral and material support of the members of the British Commonwealth of Nations, the United States of America and the remaining free peoples of the world. It must be patent, however, that in the present stage of development of modern thought, a literal interpretation of this bond as a subscription to a theological formula, as would seem to be implied, would set outside the pale not only those who are members of the other great religious systems of the world, but also those who, while intellectually 'non-jurors', have entered upon the struggle to secure the ascendancy in world affairs of that spirit which inspires Christianity, but is not peculiar to it, with a fervour and passionate devotion which has all the intensity of religious emotion. To say this is not to imply a revival of the over-long opposition of religion and science. It is rather to emphasize what has been in fact an approach to composing their differences ; but there are not lacking those who in the cause of intellectual integrity would prefer to clarify the issue and to rest upon a statement of our aim in its simplest and widest appeal as being alone acceptable to those who adopt the point of view of the rationalist.

Such a line of argument is set out, for example, by Mr. A. Gowans Whyte in "Make your own Religion" (The Thinker's Forum, London, Watts and Co., 1940. Pp. 47. 6*d*.). After passing in review the evidences of the failure of Christianity—unkindly drawn in part from the utterances of the Churches themselves—and the bankruptcy of a Christianity which alternatively depends upon a few generalized moral principles, Mr. Whyte sets out on "an adventure" towards a new religion, a religion which is "a search for the truth" and "the satisfaction of the will to know" as opposed to "the will to believe". The object of this "will to know" is the building up of a picture of the universe and man's place in it in accordance with the doctrines of evolution. Christian morality, it is argued, is not far and away superior to all other codes as the Divine law, but is as imperfect as those other codes and is subject to change in form from time to time and from place to place. The ideal on this view—a moral system which enables the individual to live "a full mental, emotional and physical life in harmonious association with others equally blessed"—is, it is admitted, still a long way ahead, but progress will depend upon knowledge of the moral evolution of mankind and upon a mind set free "to learn, to probe, no doubt, to reject, to accept, as experience and reason suggest"—in other words upon the principle of freedom of thought for which really we are fighting.

Additions to the British Flora

Although only an infinitesimal proportion of the alien plants which reach Great Britain in some form or other and take root ever succeed in establishing themselves, much less colonizing the country, a small number of additions to the flora that have established themselves in recent years from garden escapes or alien casuals of industry may have some important bearing upon the flora of the future. In 1928, F. W. Holder and R. Wagstaffe, of the Southport Scientific Society, found an alien composite with small yellow flowers at Freshfield, West Lancashire (vice county 59, botanically "South" Lancashire), which Druce afterwards identified as *Siegesbeckia orientalis*, fairly widely distributed in the southern hemisphere, but not previously recorded in Britain. In the twelve years since then, the species has firmly established a colony of plants at the Freshfield station and J. D. Massey, in a communication to the Liverpool Botanical Society, has pointed out that it differs from Ridley's description of the species in the "Dispersal of Plants Throughout the World" in growing much taller (5–6 ft.), in always possessing five long narrow bracts instead of four, and has glands on the leaves and stem as well.

About the same period, R. E. D. Baker discovered *Scirpus americanus* (Pers) by a slack on the Freshfield dunes, its only other European station being on Jersey, although W. G. Travis had an unnamed 1909 specimen from the same Freshfield site in his herbarium. Since then, the colony of *Scirpus americanus* has considerably extended on the site to about half an acre, and J. D. Massey has successfully transplanted a second colony 100 yards south. The steady colonization of the countryside by such Petasites garden escapes as the winter heliotrope and white butterbur (*P. albus*) may be emulated by another white butterbur, *Petasites japonicus*, which was recently added to the Cheshire flora (Eric Hardy, *J. Bot.*, April 1940). Wilson has noted it in Lakeland ("Flora of Westmorland"), and the former record elicited specimens in the British Museum herbarium from additional stations at Denham and Langsdale, and elsewhere from Denbighshire (*Field*, August 28).

Engineering in the University of Glasgow

In less troublous times professional engineers all the world over would undoubtedly have wished to collaborate in celebrating the centenary of so important an event as the founding in 1840 of the regius chair of civil engineering and mechanics at the University of Glasgow. The second occupant of the chair, Prof. W. J. Macquorn Rankine, was an exceptionally brilliant man to whom all fields of knowledge seemed alike, and there are few branches of engineering science to which he did not make some notable contribution. In his time there was no thought of the expansion that was soon to take place, which now makes separate subjects of civil, mechanical and electrical engineering. As *Engineering* of September 27 points out, he was also an accepted authority on naval architecture. His influence was, and still remains, potent in many branches of design. The *Glasgow Herald* of September 16 says that he was "the first really powerful thinker in this country to bring the highest mathematical resources to bear on engineering practice".

Rankine died in 1872 and was succeeded by James Thomson, brother of Lord Kelvin, who was one of the earliest to develop the large-size centrifugal pump. In 1889 he was followed by Archibald Barr, who will long be remembered for his collaboration with Dr. Stroud in the production of the Barr and Stroud range-finder. He also left an enduring monument in the James Watt Engineering Laboratories of the University which he initiated. Barr's successor was the late Prof. J. D. Cormack, during whose tenure of the chair the centenary of the death of James Watt provided an occasion for the establishment of two new chairs, in heat engines and electrical engineering. They were actually founded in 1921, and with the existing John Elder chair of naval architecture, completed (at least, for the time being) the subdivision on modern lines of the comprehensive curriculum that Rankine had undertaken single-handed, and which his own work had done so much to expand. It would be interesting to speculate how the popular attitude towards engineering in general would have been affected if its study had continued under the earlier title of 'natural philosophy'.

Electric Utilities at the New York World's Fair

In the August issue of the *Edison Electric Institution Bulletin*, Mr. Gardner Boyd sums up the results of the first hundred days of the electric utilities exhibits at the New York World's Fair. When the Fair opened its gates on April 30, the electric utility industry presented two separate exhibits to the public. One was designed to give visitors an understanding of the public service objectives and their contributions to present-day living. The other was planned to show farmers the many ways in which electricity will serve them with profit. It has been said that so far the attendance at the Fair has been poor. This is true in comparison with standards required for profitable operation determined by the Fair management in advance of the opening; but so far as the electric utilities exhibit is concerned, attendance has been excellent both from the numerical point of view and from the qualitative aspect. To August 15, the total number of visitors to the main exhibit—Forward March of America—was 3⅛ millions. It has not been possible to make a continuous count of visitors to the electrified farm. From spot checks made frequently and compared with attendance at Forward March of America for the same periods, it appears from these comparisons that the farm draws regularly 75–80 per cent as large an attendance as Forward March of America, and that the total attendance at the two exhibits up to August 15 was approximately six millions.

At the farm there is an information bureau to which many visitors turn. Primarily they want to find out more about the various appliances and pieces of electrical equipment demonstrated at the farm. In order that they may be fully served, they are asked to fill in cards giving their names and home address, the appliances about which they want information and the name of the electric utility that serves them. Many thousands of these cards have been filled up. The information on the cards is promptly forwarded to the manufacturers and others who contributed material and equipment used on the farm, and to the utility companies serving the inquiries named.

Applications of Synthetic Rubber

In an article entitled "Synthetic Rubber" appearing in the *Engineer* of September 13, Mr. A. E. Williams reviews the progress made with the synthetic rubber called neoprene, which was first developed in the United States about seven years ago by the Du Pont Company and is now manufactured by Imperial Chemical Industries Ltd. The starting point for neoprene is calcium carbide; its properties can be varied by incorporating different substances in various proportions. Generally speaking, the initial cost of synthetic rubber is higher than that of natural rubber, but owing to its resistance to temperatures above 140° F. and to acids and oils, it proves much cheaper in the long run. Exhaustive tests have been made to show its resistance to oil, and in one of these, whereas the tensile strength of natural rubber fell to 25 per cent of its original value, the strength of neoprene was reduced only to 93 per cent. It has many uses, among which Mr. Williams mentions those for driving belts, the bonding of metals, inking rollers for printing machines, hoses for petrol and oil, the protection of insulated electric cables, seals for refrigerating apparatus and the manufacture of flexible ebonite, a substance finding many different applications in industry.

Hemp Drug Addiction in India

The October issue of the *British Journal of Inebriety* contains an instructive article by Brevet-Colonel R. N. Chopra and Captain G. S. Chopra of the School of Tropical Medicine, Calcutta, on the present position of hemp drug addiction in India. Hemp drugs in India are at present used in three forms, namely, *bhang*, which is taken as a beverage, while *ganja*, which is nearly four or five times more potent, and *charas*, the effects of which are even stronger than those produced by *ganja*, are mostly smoked. The cultivation of the hemp plant which grows wild in Northern India along the southern slopes of the Himalayas is strictly controlled for narcotic purposes. The total consumption of hemp drugs in British India during 1934–35 amounted to 1,031,496 lb.

According to the writers there are at least between 855,844 and 1,000,000 hemp drug addicts in India, or approximately 0·5–1 per cent of the total population. The main causes of addiction in order of frequency are association with other addicts, religious and emotional factors, substitution for other drugs, disease and minor ailments, and hard work, worry or strain. The commonest age to contract the habit is between twenty-one and thirty. The effects of the drug on the central nervous system can be divided into three stages: first, the stage of primary stimulation and excitement; secondly, the stage of depression and anæsthesia; and thirdly, the stage of secondary stimulation and excitement. Moderate habitual use may not be attended with harmful effects, but continued excessive indulgence impairs the normal functioning of the nervous system, renders the addict incapable of mental exertion and causes general debility and premature decay.

Robert Boyle

ALTHOUGH Robert Boyle (1627–1691) is well known for his law of compression of gases and for his clear definition of a chemical element (given in his "Sceptical Chymist", 1661), his many other services to chemistry and physics are less appreciated. M. Schofield (*Chem. and Ind.*, 59, 615; 1940) has sketched some of these. Boyle's work in physics centred around his air pump, several models of which were constructed, and his experiments in a vacuum are of considerable interest, particularly in connexion with the barometer, the fact that sound is not propagated in a vacuum, and the boiling of water under reduced pressure. Experiments on freezing mixtures and hydrostatics, including the measurement of specific gravities, were also carried out by Boyle. In the field of chemistry he criticized the prevailing views on elements and pointed the way to a correct view of these, made experiments on combustion which emphasized the importance of the air, investigated the action of acids and alkalis on indicators, prepared phosphorus and ether, and was near the correct interpretation of respiration.

Dr. Désiré Bourneville

DR. DÉSIRÉ MAGLOIRE BOURNEVILLE, a pioneer in the welfare of defective children, was born at Garencières in Normandy on October 21, 1840. He studied medicine in Paris, where he qualified in 1870. Three years later he founded *Le Progrès Médical*, which soon became one of the leading French medical journals. In 1879 he was appointed senior physician to the Bicêtre infirmary, where he took charge of a service almost entirely devoted to idiocy and other forms of mental defect in children and published the *Comptes rendus de Bicêtre*. In the following year he founded the *Archives de Neurologie* under the patronage of Charcot, whose works he had edited some years previously. Bourneville was one of the first in France to confirm Hertoghe's observations on thyroid cachexia and to prove the value of thyroid medication. He was also the first to describe the association of sclerotic nodules in the brain with mental defect and epilepsy which is known as tuberous sclerosis. He took an active part in the laicization of hospitals and in the foundation of training schools for nurses at La Salpêtrière, Lariboisière and Pitié hospitals. In 1905 he retired from the Bicêtre infirmary and was appointed director of the Vallée Foundation for the treatment of idiots and mentally defective children. He died on May 28, 1909.

Luigi Bodio

LUIGI BODIO, a celebrated Italian statistician, was born at Milan on October 12, 1840. After serving as lecturer in economics in the Technical Schools of Leghorn, Milan and Venice, he was appointed first permanent secretary of the Central Office of Statistics and in 1878 its director. In 1885 he was elected secretary to the International Institute of Statistics and in 1905 director. In 1901 he was made a senator of Italy. His writings were numerous and varied, the most important being on external commerce (1862), statistics in relation to politics, economics and allied sciences (1869), movement of population in Italy and other European States (1878) and Italian emigration (1894). He died on November 2, 1920.

Amerindian Relics

SOME notable additions to the collections of the Smithsonian Institution illustrating the culture and history of the North American Indian peoples are recorded in communications recently issued by the Institution from Washington. The ethnographical interest of these objects is considerably enhanced by their historical and personal associations. Two corn husk dolls, for example, presented by the widow of the late J. N. B. Hewitt, who was the foremost authority of recent times on Iroquois culture and philosophy, are notable as being an exact reproduction of the dress of a man and woman of the Iroquois as described in contemporary accounts at the close of the eighteenth century. The Iroquois Federation of the Five Nations, founded in the seventeenth century, played a part of no little importance in the War of American Independence, though disrupted by a divided allegiance. The dresses of both male and female are of blue broadcloth decorated with glass, shell and porcelain beads and coloured ribbons. That of the woman is particularly elaborate.

Among Indian leaders in the war of resistance to the authority of the United States of the later nineteenth century, Sitting Bull, chief of the Sioux, won something of a world-wide reputation. Even in America, where at one time he was regarded as the worst of "bad Indians", he is now often made a symbol of the struggle of the Indian against conquest and absorption by the white race. Sitting Bull was a shaman or religious leader rather than a war chief in accordance with the dichotomy of function usual among these proples. Authentic relics of this chief are rare, although pairs of moccasins said to have belonged to him are found in collections scattered widely over America and Europe. The authorities of the Smithsonian Institution hitherto have allowed authenticity to one relic only in their collections, a sawed-off flint-lock taken at the time of his surrender. To this is now added a red clay tobacco pipe and buckskin tobacco pouch presented by the widow of Major-General James McArthur, who obtained them from the chief when he himself was a lieutenant in the Seventh U.S. Infantry. The pipe is of catlinite, the red clay of the Upper Missouri, commonly used by the Indians for this purpose, and has a long rectangular wooden stem. The pouch is 17 inches long with characteristic Sioux decorative work in glass beads and dyed porcupine quill.

New Fossil Primate from Sterkfontein, South Africa

Further study of the large human-like third upper molar of which the discovery at Sterkfontein was recorded recently by J. C. Middleton Shaw in the columns of Nature (**143**, 117; 1939) and a comparison with remains of the fossil Plesianthropus and Paranthropus of Broom have led to some interesting conclusions as to the possible significance of this new Sterkfontein primate. These further considerations have been discussed by Dr. Shaw in a communication to the *Annals of the Transvaal Museum* (**20**, 2; 1940). There would appear to be no doubt that the new molar belongs to neither Plesianthropus nor Paranthropus; and it differs from the third molars in all the material from fossil apes which has been described by W. K. Gregory. If, therefore, it belonged to a fossil ape, it must be concluded that that ape differed, at least so far as the upper third molar is concerned, from any ape hitherto described.

Evidence of the character of the corresponding tooth in fossil man, unfortunately, is inadequate. Dr. Shaw, however, detects certain resemblances between his tooth and that in Sinanthropus, except that it is larger and presents certain differences as to the crown, while there is, again with the same proviso as to size, a resemblance in the moderate taurodontism and smooth simple crown surfaces to certain Neanderthal specimens. Although no fossil human remains have been discovered at Sterkfontein, Dr. Shaw puts forward the tentative suggestion that the tooth of his discovery may be a relic of an early African human type, possibly of Pleistocene age and, therefore, a contemporary of Plesianthropus and Paranthropus. If this should be confirmed by further evidence, this is the first fossilized remains of man discovered in the Union of South Africa.

Excavation at Gnezdovo, U.S.S.R.

Soviet archæologists have recently made interesting discoveries during excavations at the village of Gnezdovo, near Smolensk. The vicinity is a veritable treasure-house of Slavonic monuments; in it are up to 7,000 tumuli, numerous settlements and small towns relating to the first 1,000 years before our era. Excavations have been completed of the central town at Gnezdovo, considered by many archæologists as the original town of Smolensk. An area of 120 square yards was uncovered up to an average depth of 6½ ft. In one half of the excavated area was revealed an ancient Slavonic earthen dwelling place with a stone fireplace and hearth and many utensils. There were found bone, flint and iron implements, and primitive clay pots. Copper articles (clasps and buckles) found there indicate that the dwelling place relates to the middle of the first 1,000 years of our era.

In the other half of the site excavated was discovered a very rare burial; lying on a funeral pyre was a half-burned woman in full attire and wearing many ornaments. Around her throat was a valuable necklace; suspended from a silver chain was a golden Byzantine coin, six highly ornamented gold medallions and five silver medallions. Below the medallions hung a number of multi-coloured beads, including silver ones. It is believed that the burial relates to the tenth century, and that the ornamentation is of Byzantine origin.

Gold Mining in Wales

Mining for gold has been carried on in various parts of Wales during the past two thousand years, but has experienced many vicissitudes and has frequently lapsed for long periods at individual workings. An attempt was made some three years ago to bring again into commercial production the Roman Deep mine at Pumpsaint, Carmarthenshire, but circumstances were adverse to the venture. According to *Engineering* of September 20, the plant has now passed into the hands of Messrs. George Cohen, Sons and Company, Ltd., for disposal. Local tradition says that the name 'Pumpsaint', which means five saints, is linked with a stone, having in one surface five small depressions, supposed to have been caused by the heads of five saints who used it as a pillow. Messrs. Cohen suggest that the hollows were caused by primitive ore-crushing stamps, and that the stone was part of the very early plant used at the mine.

The Start of Education

"Elementary Education: What is It?" (U.S. Office of Education, Bulletin 1940, No. 4, Part 1) is the first of four summaries which have followed a conference in 1938 on the subject. It is planned to give a bird's-eye view with relation to later studies and is valuable as presenting the views and criticisms of many teachers, though a little heavy in its methods of exposition. The general public needs to realize in simple language that the word 'education' means not pushing in information but drawing out the best that a child can do. To note among the experiences to be included in an elementary school "analysing" and "evaluating" seems rather advanced for a tender age, unless the child's determining of values provides hints for the teacher; one of Mark Twain's clever children valued her mother most and the new kitten came next. Elementary schools hold the centre of the stage so far as numbers are concerned. There were in the United States nearly 23 millions of the teachable in 1936, and between that date and 1930 a decrease of 4 per cent in attendance is noted. But States vary widely in the opportunities they supply.

What is said of a broad interpretation of the curriculum and of mental growth is excellent. Dramatic play, begun naturally by children as individuals, should be organized as a regular part of the school programme. It is well to take long views about later life, where education goes on steadily among the wise. The main business is to discover a child's special aptitudes and get over a reluctance to tackle subjects which may appear difficult, such as arithmetic. But, while there is talk of a "stable and desirable type of personality" as one of the aims to be achieved, and of democracy and good citizenship, we find nowhere any declaration whether the child is to be educated to meet the current standards in business, or to reach a higher morality which is dissatisfied with them. Culture has in practice little chance of competing with the attractions of that broad way, the *via dollarosa*.

Recent Earthquakes

Four strong distant earthquakes were registered at Kew Observatory during September. They were on September 12, 19, 21, and 22. The second of these was the greatest, having a ground amplitude at Kew of 47 μ, and being estimated at a distance of 17,400 km. The second was at a distance of 6,100 km. with an estimated depth of focus of about 390 km., whilst the third, probably distant about 140°, had a depth of focus of approximately 500 km. News from other observatories is awaited before the epicentres and depths of focus can be given with precision.

On September 4, two local earthquakes were felt in Palestine each of which lasted about 10 seconds. No damage has been reported and the shocks were not registered at Kew. It is reported in the Press that an earthquake was felt in Copenhagen early on September 28. No damage was reported. Earthquakes are rare in this district and the shock may have been caused by fault slipping in the Sound separating Denmark from Sweden.

The coast of Chile in the neighbourhood of Iquique was shaken by a violent earthquake about 6 a.m. (local time) on October 4. Reports of damage and details of the shock are not yet to hand. Chile as a whole is very liable to earthquake shocks, and Iquique has been affected on a number of occasions in the past, notably on May 9, 1877, when there was widespread destruction due to large sea waves caused by the earthquake in addition to the extensive damage done by the earthquake itself, and on January 23, 1878.

During April, May, June 1940 forty-seven earthquakes were registered at the Riverview College Observatory, New South Wales, as compared with fifty-six in the first quarter of the year. The Observatory is equipped with two Wiechert horizontal 1,000 kgm. instruments, one Wiechert vertical seismometer of 80 kgm., two Mainka 450 kgm. seismometers and three Galitzin aperiodic seismometers with galvanometer registration, orientated north-south, east-west and vertical. The largest two shocks of the period appear to have been on April 1 when an amplitude of 23 mm. was obtained and on May 28 when an amplitude of 22 mm. was reached. The shock of April 18 was felt in the region of the Duke of York Islands, New Britain, etc. The shock of May 24 is reported to have had its epicentre in Peru, and the earthquakes of June 18 and June 22 were deep focus shocks. The instruments are occasionally affected by microseisms which are at times severe. The microseisms do not often preclude the accurate reading of the seismograms, details of which are given in the Observatory report.

Research on Juvenile Leisure

The Socio-Psychological Department of the Manchester and Salford Council of Social Service is engaged in research into the problems of leisure time activities of juveniles. The research at present is centred around the psychological difficulties of juveniles in taking up educational leisure-time occupations. The department wishes to get in touch with those who have conducted similar research in order to co-operate and co-ordinate the research done. Information can be obtained from G. Wagner, Manchester and Salford Council of Social Service, 16–18 Queen Street, Manchester 2.

Announcements

Prof. A. Einstein, who has been professor of theoretical physics in the Institute for Advanced Studies at Princeton since 1933 has been admitted to American citizenship.

Dr. Milan A. Logan, assistant professor of biochemistry at Harvard University, has been appointed Andrew Carnegie professor of biochemistry in the College of Medicine of the University of Cincinnati, in succession to Dr. Albert C. Mathers.

Dr. W. A. Clemens, director of the Pacific Biological Station at Departure Bay, a branch of the Fisheries Research Board of Canada, has been appointed head of the Zoology Department of the University of British Columbia.

The Academy of Sciences of the U.S.S.R. has awarded the Pavlov Prize for 1940 to Prof. Maria K. Petrova, of the Pavlov Institute of Physiology and the Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity. The annual Pavlov Prize of 20,000 roubles, for the best work in the field of physiology, was instituted by the Soviet Government in 1936. The winner of the Prize this year is known for her study of experimental neuroses, their mechanism and therapy. She has written a treatise on this subject, one volume of which has been published, and the other is in the press.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

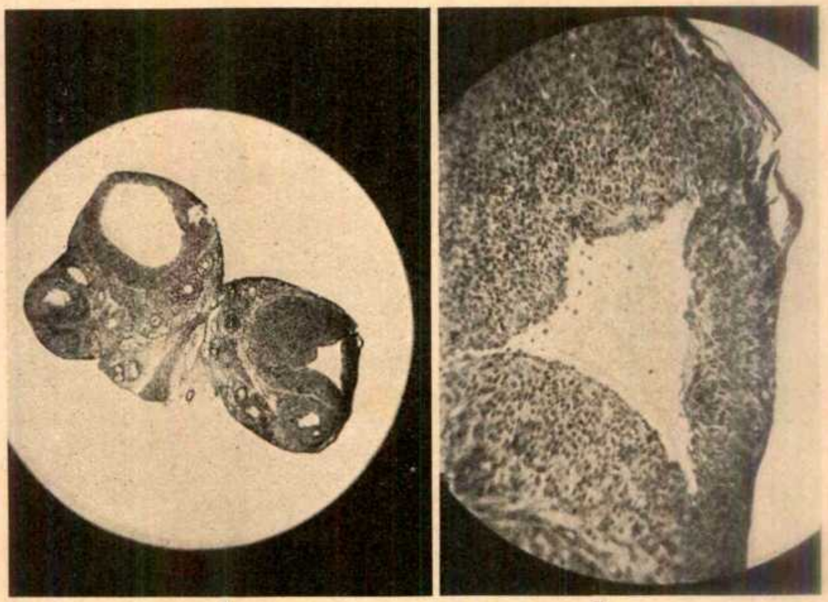
In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Gonadotropic Hormones in the Urine of the Giraffe

It has been considered that during pregnancy only the primates excrete gonadotropic hormones in high concentration in the urine, and that pregnant Equidæ do not, although the concentration of gonadotropic substances may be increased in the blood. It was not expected that antelopes would give positive results.

We had occasion to examine the urines from a number of captive giraffes and the following preliminary results are of importance.

The first animal, a female 2-para, aged six years, was mated on December 24, 1937, and her female calf was born on April 8, 1939 (468 days).



A *B*

Examination of the urine for gonadotropic hormone gave a negative result on August 24, 1938, but later specimens examined on November 11 and 26, 1938, showed positive ones when tested on rats and mice by the method of Ascheim and Zondek. Thus a group of 12 rats receiving 3·6 c.c. of the latter two urines, which were shaken out with ether before injection, gave the following results :

	No. of rat	Body-weight	Œstrus	Weight of the ovaries	Histology of the ovaries
Nov. 11, 1938.	18871	26·6 gm.	*G*	11 mgm.	III
	18872	28·0 ,,	*G*	9 ,,	I
	18873	28·0 ,,	*G*	11 ,,	III
	18874	30·4 ,,	*G*	13 ,,	III
	18875	25·8 ,,	*D*	9 ,,	—
	18876	26·8 ,,	*F*	14 ,,	III
Nov. 26, 1938.	19099	29·0 ,,	*G*	16 ,,	III
	19100	27·8 ,,	*A*	10 ,,	I
	19101	26·6 ,,	*A*	9 ,,	I
	19102	27·0 ,,	*G*	11 ,,	III
	19103	26·0 ,,	*A*	6 ,,	—
	19104	30·4 ,,	*B*	8 ,,	I

A=typical anœstrus vaginal smear; *B*=decreased number of leucocytes, increased number of not cornified epithelial cells; *G*=a vaginal smear with less than 5 per cent of leucocytes and more than 95 per cent cornified epithelial cells; I=enlarged follicles present; III=corpora lutea present.

The typical effects in the ovary of rat 19102 are seen in the two accompanying illustrations; *A* shows a section from the whole organ and *B* a young corpus luteum at higher magnification. The changes produced are comparable with those found in rats after the administration of gonadotropic hormones of the chorionic type (few but large corpora lutea).

Examinations of the urines from other non-pregnant female giraffes and also a male giraffe gave negative results.

Our preliminary results thus indicate that the excretion of gonadotropic hormones during pregnancy is not limited to the primates as is generally assumed, but also occurs in the antelopes. We are continuing this work and are now repeating our observations on the original female giraffe.

John F. Wilkinson.
P. de Fremery.
Dept. of Clinical Investigations and Research,
Manchester Royal Infirmary and University,
and
Organon Laboratories, Oss.

August 31.

Volatile Aldehydes Liberated by Periodic Acid from Protein Hydrolysates

Nicolet and Shinn[1] and Van Slyke *et al.*[2] have studied the action of periodic acid on hydroxyamino-acids, and in the cases of serine and hydroxylysine have demonstrated the rapid formation of one molecule of formaldehyde. Block and Bolling[3] have made use of the rapid formation of one molecule of acetaldehyde from threonine on oxidation with lead tetracetate for determining this amino-acid in protein hydrolysates.

We find that periodic acid in an aqueous solution of sodium bicarbonate rapidly liberates acetaldehyde from threonine; the acetaldehyde was identified as the 2 : 4-dinitrophenylhydrazone. In quantitative work the volatile aldehyde liberated was determined by the method of Friedemann and Kendall[4] after aeration from the reaction mixture into an absorption tower containing bisulphite solution. Under the same conditions serine gave no volatile aldehyde. This is in agreement with the published data[5] on the vapour pressure of formaldehyde in aqueous solution at room temperature. Thus aeration affords a simple analytical procedure for the separation of formaldehyde from other lower aliphatic aldehydes in aqueous solution.

Under the same conditions, alanine, cystine, methionine, hydroxyproline, β-hydroxyglutamic acid, tyrosine, tryptophan, arginine and histidine yield no volatile aldehyde.

We have determined the volatile aldehyde liberated in this manner from various protein hydrolysates. The proteins were hydrolyzed with HCl, and excess of this was removed by repeated evaporation *in vacuo* before treatment with excess of HIO_4-$NaHCO_3$ at room temperature. The following values were observed:

Protein	Volatile aldehyde as N in % of total N of protein (1 mol. aldehyde = 1 atom N)
Wool (Merino 64s)	3·3
Casein	2·1
Gelatin (Coignet Gold Label)	1·0
Wheat gluten	1·2

Volatile aldehyde was in each case recovered in good yield from threonine added to the protein hydrolysate before the determination.

The volatile aldehydes were examined qualitatively by conversion to the 2 : 4-dinitrophenylhydrazones, which were identified by comparison with authentic aldehyde dinitrophenylhydrazones and mixtures of these derivatives. Melting points, mixed melting points and X-ray powder photographs were employed, the X-ray work being kindly carried out by Dr. W. T. Astbury, Dr. Florence O. Bell and Dr. K. M. Rudall, of the University of Leeds.

In the cases of wool, casein and gelatin only the acetaldehyde derivative was obtained, but with gluten a mixture of the dinitrophenylhydrazones of acetaldehyde and propionaldehyde resulted. The X-ray photographs seem to be conclusive that the mixture contains the propionaldehyde derivative besides that of acetaldehyde, but there are strong indications that the two form mixed crystals in certain proportions, and the presence of derivatives of still higher aldehydes is not definitely excluded. Both these latter aspects of the matter are being investigated further.

The liberation of propionaldehyde suggests, by analogy with the behaviour of threonine, that β-hydroxynorvaline may be present in the hydrolysate of gluten. It is interesting in this connexion to note the reported isolations from oatmeal protein[6,7] and zein[8] of preparations having the elementary composition of hydroxyvaline. No structural evidence was published in respect of these. Abderhalden and Heyns[9] prepared from synthetic β-hydroxyvaline and β-hydroxynorvaline the derivatives made by Schryver and Buston[6] and by Brazier[8] and found no agreement in properties; the preparations from protein were optically inactive, and Abderhalden and Heyns employed the racemic compounds for comparison. They did not, however, in the case of β-hydroxynorvaline take into account the existence of two centres of asymmetry in the molecule, which leads to four active and two racemic isomers. A specimen of the product of Czarnetzky and Schmidt[7] was considered by them to be leucine.

It is intended to undertake an isolative investigation of the substance giving rise to propionaldehyde.

A. J. P. Martin.
R. L. M. Synge.
(International Wool Secretariat Student)

Wool Industries Research Association,
Torridon, Headingley,
Leeds, 6.
September 6.

---

[1] Nicolet and Shinn, *J. Amer. Chem. Soc.*, **61**, 1615 (1939).

[2] Van Slyke, Hiller, MacFadyen, Hastings and Klemperer, *J. Biol. Chem.*, **133**, 287 (1940).

[3] Block and Bolling, *J. Biol. Chem.*, **130**, 365 (1939).

[4] Friedemann and Kendall, *J. Biol. Chem.*, **82**, 23 (1929).

[5] Blair and Ledbury, *J. Chem. Soc.*, 26 (1925); Ledbury and Blair *ibid.*, 2832 (1925).

[6] Schryver and Buston, *Proc. Roy. Soc.*, B, **99**, 476 (1925).

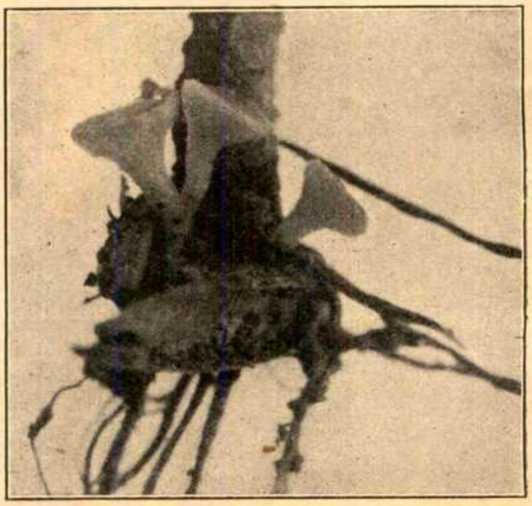
[7] Czarnetzky and Schmidt, *J. Biol. Chem.*, **92**, 453 (1931).

[8] Brazier, *Biochem. J.*, **24**, 1188 (1930).

[9] Abderhalden and Heyns, *Ber. deutsch chem. Ges.*, **67**, 530 (1934).

Blind Seed Disease of Rye-Grass

With reference to the communication from Muskett and Calvert[1], we wish to record that in 1891 Prillieux and Delacroix[2,3] described, in France, a parasite *Endoconidium temulentum*, on rye (*Secale cereale*), which possessed toxic properties. The genus Endoconidium was based on this fungus on account of the endogenous formation of its microconidia. Its perfect stage was later variously ascribed to the genera Phialea, Stromatinia and Sclerotinia. In the blind seed fungus we have found that the microconidia are produced endogenously as in Endoconidium; measurements of the apothecia, ascospores and microconidia agree closely in the two fungi; also



positive results have recently been obtained by infecting the flowers of rye with spores of the blind seed fungus. The only point of difference is that macroconidia have not been described in Endoconidium.

Then while Muskett and Calvert[1] report apothecia of the blind seed fungus only on dead rye-grass seed, we have found as many as three of these apothecia on a caryopsis which has given rise to a perfectly normal seedling, as shown in the accompanying figure. This suggests that the fungus does not always behave as a pathogen. Several systemic fungi have already been reported on *Lolium perenne*; McLennan[4,5] has described one endophyte and one mycorrhizal fungus, Sampson[6] a second endophyte which produces microconidia, and Neill[7] has described an endophyte which may be identical with that described by McLennan; this last was found in the course of an investigation into a suspected herbage toxin. The results of our cultural experiments suggest that these systemic fungi may not be entirely dissociated from one another or from the blind seed fungus.

With regard to the Pullularia occurring along with the blind seed fungus, our experiments have had similar results to those reported by Muskett and Calvert; it appears that Gemmell[8] described the blind seed fungus under the name *Pullularia pullulans*.

A consideration of the foregoing statements indicates that neither the cause of the low germination of rye-grass nor the identity of the associated fungi has yet been adequately investigated. A fuller account of work on these points will be published in due course.

In view of the recent letter from Glasscock[9] on this subject we should like to emphasize that infection with the "blind seed fungus" is not necessarily correlated with low germination in rye-grass. In a recent test, of 19 seeds bearing conidia of the fungus 13 germinated and have given rise to normal plants.

MALCOLM WILSON.
M. NOBLE.
E. G. GRAY.

Department of Mycology,
University of Edinburgh,
and
Plant Pathology Service,
Department of Agriculture for Scotland.

---

[1] Muskett, A. E., and Calvert, E. L., NATURE, **146**, 200 (1940).
[2] Prillieux, E., and Delacroix, G., *Bull. Soc. Myc. Fr.*, **7**, 116 (1891).
[3] Prillieux, E., and Delacroix, G., *Bull. Soc. Myc. Fr.*, **8**, 22 (1892).
[4] McLennan, E., *Proc. Roy. Soc. Vict.*, **32**, N.S. 252 (1920).
[5] McLennan, E., *Ann. Bot.*, **40**, 43 (1926).
[6] Sampson, K., *Trans. Brit. Myc. Soc.*, **21**, 84 (1937).
[7] Neill, J. C., *N. Zealand J. Sci. Tech.*, **21**, 280A (1940).
[8] Gemmell, A. R., *W. Scot. Agric. Coll. Bull.*, 136 (1940).
[9] Glasscock, H. H., NATURE, **146**, 368 (1940).

Non-parallelism of Lattice Planes in Tin Coatings on Steel

X-RAY and optical examination of the crystals of the tin layer of tinplate has shown that a continuous change of orientation takes place along such crystals in their direction of growth.

Back-reflection X-ray photographs taken at a series of points along such a crystal are characterized by a movement of the reflection spots from one photograph to the next. Photographs taken with the specimen moved uniformly during the exposure consist of continuous lines instead of spots. It follows that a change of orientation takes place along the crystal, and that this change is continuous.

Visual inspection of an etched surface of such a crystal, or inspection by the optical method previously used for the determination of the orientation of tin crystals[1] confirms the existence of the effect. It is observed in exceptional cases that the crystals undergo several complete rotations, as evidenced by the periodic appearance of bright patches on the etched surface. The extent of the rotation is variable, but in the few cases where it has been measured it has had values up to 40° per cm.

The proposed explanation is that the conditions of formation of the layer cause a greater concentration of iron in the tin near the tin-iron interface than at the free surface, and that this causes a gradual contraction of the lattice as the interface is approached. Calculation shows that a contraction of the lattice of 0·04 per cent at the tin-iron interface would introduce a departure from parallelism in the lattice planes sufficient to account for the observed rotation.

It is also suggested that this explanation may apply to the striated structure sometimes observed in the tin layer on copper tinned by hot-dipping[2].

It is to be expected that this type of 'non-parallel crystal lattice' would be present wherever a concentration gradient exists as, for example, in cored crystals, under such conditions that the lattice spacing depends on the concentration.

It is hoped that a full investigation of this effect will be undertaken in due course, but the present abnormal conditions may cause considerable delay in full publication.

BRUCE CHALMERS.

International Tin Research and
Development Council,
Fraser Road,
Greenford,
Middlesex.
September 16.

---

[1] *Proc. Phys. Soc.*, **47**, 733 (1935).
[2] *Trans. Farad. Soc.*, **31**, 1299 (1935).

Submarine Canyons

PROF. W. H. BUCHER, as reported in NATURE[1], argues that the marvellous submarine canyons of the continental slope are due to tsunamic (or tunamic) waves. I am delighted to find this view advanced by so competent an authority, for though I gave evidence for its adoption in 1938[2], my voice has been as of one crying in the wilderness. In fact, Prof. Douglas Johnson, in an approximately complete recent survey of the subject[3], has overlooked the seismic possibility altogether, except for very limited applications put forward by Prof. F. P. Shepard[4] from 1931 onwards.

E. B. BAILEY.

Geological Survey and Museum,
London, S.W.7.

---

[1] Bucher, W. H., NATURE, **146**, 407 (1940).
[2] Bailey, E. B., *Trans. Geol. Soc. Glasgow*, **20**, 1 (1938).
[3] Johnson, Douglas, "The Origin of Submarine Canyons" (New York, 1939).
[4] Shepard, F. P., *U.S. Coast and Geod. Surv. Assoc. Field Eng.*, Bull. **3**, 87 (1931).

RESEARCH ITEMS

Archæology of Fanning Island

Further information relating to the ruins of Fanning Island, one of the equatorial islands of the Pacific, was obtained by Kenneth P. Emory in 1934 when he visited the island again after an interval of ten years (Bernice P. Bishop Museum, *Occasional Papers*, **15**, 17 ; 1939). Three additional ruins were noted and examined and four basalt adzes found after the departure of the first expedition were studied. The three ruins now described lie on a ridge of sand along the south side of a trail from the lagoon jetty and the cable station. Of the first only a small pile of coral 10 ft. in diameter and a foot high remains. Several small slabs on edge are planted here and there, and an area less than 16 ft. is covered with scattered stones. The next structure, nearly 60 yards to the west, is a small collection of loose slabs which may originally have formed an alignment. The third ruin, 47 yards farther west, is the most definite. It seems to have been a mound or platform covering two vaults constructed at ground-level. At the south end kerbs mark a rectangle 6 ft. by 10 ft. Around the outside edges are many loose slabs in disorder and smaller stones which must have served as the fill of a grave or have formed a platform built over the vault. Human teeth, fishbones and one-piece fishhooks found within the rectangle point to its use as a grave. Firmly embedded kerbs and two large limestone slabs north of the rectangle suggest another grave. There is a suggestion of a retaining wall at the north border of the ruin. About 400 ft. south-west is a place where limestone slabs had been quarried in ancient times. The four adzes resemble those of Samoa and Tonga, and not those of the Marquesas, Hawaii, Cook Islands, Society Islands and other groups of marginal Polynesia. The fishhooks, composite and one piece, relate to Tonga. The dressed stone enclosure has affinities with the royal burial places of Tonga and its sixteenth century dressed stone work, but nothing like it is found outside Tonga. The marking of burials with conspicuous superstructures of stone is a strong feature of western Polynesia, weak or absent in eastern and marginal Polynesia.

Folding of the External Ear of Lorisoid Monkeys

The ear pinna of Galagos and their relatives is capable of a peculiar folding designed to protect a sensitive organ and brought into action when the animals desire to avoid objects which might cause physical injury. If some object is suddenly thrust towards the ear it immediately retracts, and retraction is the typical condition in sleeping animals. W. C. Osman Hill finds that the ears of the Lorisoid genera Loris, Nycticebus and Galago are characterized by having transverse discontinuities in their cartilages near the upper extremities (*Ceylon J. Sci.*, Sect. 13, **22**, 135 ; 1940). These discontinuities are bridged over by perichondrium and are connected with the presence of a lamina of striped muscle fibres (corrugator pinnæ) under the control of the will. Some of the differences between Loris and Nycticebus on one hand and the Galagos on the other are associated with the more active habits of the latter, which demand a more sensitive, in other words a more expanded organ, and hence one that is more actively contractile. Tarsius differs from these genera in lacking all these specialized structures, but is more typical in possessing a tragus.

Californian Trout

Compared with the meagre range of trout species in Britain, Californian rivers and lakes contain remarkable variety. John O. Snyder lists nine species of Salmo belonging to the rainbow trout series, four species in the "cut-throat" series, and one species of char, *Salvelinus spectabilis*. Not satisfied with these, enthusiasts have introduced Loch Leven trout from Scotland, and four other species from various parts of the United States (*Calif. Fish and Game*, **26**, 96 ; 1940). Short descriptions of all these species, some illustrated by photographs and coloured plates, indicate salient characters, and brief accounts of migration and the barriers to migration, scale-reading, conservation, food-habits, artificial propagation and distribution have been contributed mainly for the information of anglers and the inquiring layman.

Ripening of the Banana

The banana differs from many other fruits in that cut from the tree (after allowing some forty days for early stages of development) it will continue to ripen—none the less the developmental processes at work whilst on the tree probably have a determining influence in respect of the time limits at which fruit may be cut for exportation. Considerable practical importance probably is attached, therefore, to such studies as those described by H. R. Barnell, of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad (*Ann. Bot.*, N.S., **4**, 1940). He has followed the changes in dry matter and various types of carbohydrates and acidity in the pulp and skin of the fruit, during development in the plant, from the time the fruits emerged until they rotted. It had been proposed to study the quality of fruit left to ripen on the plant, but in these Trinidad observations, after the 'hundredth' day, the fruit began to split and then to fall and rot. It would seem that the Gros Michel variety under these conditions is more suited to picking at an incipient ripening stage and export than for home consumption as ripe fruit gathered from the plant. The banana is relatively unusual also in the low sugar content in the early stages of development, when starch is rapidly accumulating ; the splitting later is associated with a rise in water content of the pulp as the sugar content begins to increase. Off the plant bananas at this period will ripen with sugar formation in the pulp, but there is less danger of splitting as only a relatively small amount of water can migrate into the pulp from the skin. Unlike the apple in its high starch accumulation and low sugar concentration, the banana also differs in that along with starch synthesis there is a continuous fall in the acidity of the pulp—rising acidity values are only met with as starch hydrolysis begins after about the 'hundredth' day.

Life-Cycle of *Blastocladia Pringsheimii*

The discovery, by Kniep in 1929, that the water mould *Allomyces javanicus* exhibited heterogamy of flagellate gametes, focused attention upon closely related fungi for the possibility of similar phenomena. Elizabeth Blackwall has studied the life-history of an allied species, *Blastocladia Pringsheimii* (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 68–86; June 1940). Resting spores were successfully germinated, but no gametes were demonstrated. Motile swarmers appeared, however, and formed germlings which grew directly into the characteristic pustule. There is, therefore, as yet no evidence of a sexual phase in this life-cycle, but the demonstration of apparently non-sexual swarm spores in a Phycomycete is nevertheless of considerable mycological interest.

Genetics of Verbena

G. H. Beale (*J. Genetics*, **40**, 339–358; 1940) shows that the garden Verbena derives its variation from two sources. The first source is derived from hybridization between four species of Verbena. Eight gene differences are presumably derived from this hybridization; these show various degrees of dominance. On the other hand, ten gene differences resulting from mutation during the last hundred years show complete dominance of the 'wild type'. There are two series of triple allelomorphs in which the extreme dominant and recessive members produce a similar phenotypic effect, which differs from the intermediate member of each series. Aberrant ratios, modifying factors and exceptionally close linkages are probably related to the hybrid origin of the garden Verbena.

Theory of Differential Periodicity

G. F. Sleggs (*J. Genetics*, **40**, 385–392; 1940) has amplified his theory of differentiation of an organism. He suggests that differentiation is due to the direct action of genes which are arranged on the chromosome at various angles of rotational stagger. The formation of new nuclei is equivalent to the spreading of chemical lattices in superimposition, thus producing an optical pattern. Such staggering of genes in the chromosome column produces strain which gives rise to the high synthetic activity of living matter. Sexual interaction involves chemical union between gene columns of different stagger form, thus intensifying synthesis (growth) in the diploid. Crossing-over, dominance, lethal genes, the origin of species, and species divergence are discussed in relation to this theory.

Use of Refrigeration to Delay Age-hardening

The age-hardening which takes place in duralumin after the normalizing treatment brings about a pronounced and rapid decrease in ductility. Whereas the effects of age-hardening on the proof stress, ultimate strength, and hardness require about four days for completion, a decrease in ductility sufficient to interfere seriously with cold-pressing operations takes place in rather less than two hours. It is known that the rate of age-hardening can be retarded by lowering the temperature of storage of the freshly normalized material. Experiments have been carried out by Arrowsmith and Wolfe (*J. Inst. Metals*, **66**; 1940) to demonstrate the relationship between this temperature and the rate of age-hardening, with the object of determining the maximum temperature at which a desired increase in permissible storage time can be obtained. A practically convenient time is four days, and this is made possible by storing at a temperature of −6° to −10° C.

Impregnation of Poles with Copper Sulphate

An abstract of an article by Yosio Nakazima, on the rapid deterioration of poles impregnated with copper sulphate, has been published in the April number of the *Quarterly Journal of the Institute of Electrical Communication Engineers*, Tokyo. The author, who is a member of the Sendai Bureau of Communications, gives an account of an investigation carried out to find why copper sulphate impregnated poles erected in a certain district by the Sendai Bureau deteriorated so rapidly. Experimental investigation showed that it was due to the properties of the ground where the poles were erected, the ground becoming alternately moist and dry and thus dissolving the copper sulphate. A preserving band for preventing this was purchased in the market, but it was no more effective than the procedure previously carried out of scraping away the rotted portion and coating it with creosote. Poles impregnated with creosote by the Bessel process are best suited to this kind of soil. In the present method of investigation, much importance is placed on the amount of copper sulphate per average cubic metre, and little attention is given to the uniformity of the cross-sectional presentation. It was found that this uniformity was most important. It is believed that by diluting the solution used at present for impregnation to a density that would deposit about 3·5 kgm. of copper sulphate, and by impregnating the pole well and uniformly, the same degree of protection can be attained as in present practice. This subject well deserves further study, especially from the economic point of view. The original paper gives a discussion of the method used at the Sendai Bureau of Communications for testing the finished impregnation.

Solar Faculæ and Solar Constant Variations

H. Arctowski read a paper on this subject at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The daily solar constant values for the years 1926–1930 have been compared with the areas of faculæ in order to search for the direct correlation between solar phenomena and the variations of solar radiation advocated by C. G. Abbot. The solar constant data have been taken from vol. 5 of the *Annals* of the Astrophysical Observatory of the Smithsonian Institution and those of the areas of faculæ from the results of measures made at the Royal Observatory, Greenwich, of photographs of the sun taken at Greenwich, at the Cape and in India. It has been found that the mean values for the days of maxima and minima of the solar constant and the five days preceding and following these days give curves similar to those of the faculæ of the same dates. The mean maximum as well as the mean minimum of the solar constant variation, however, are slightly in advance of those of the faculæ.

DRUGS AND WAR-TIME ALTERNATIVES

FOR the guidance of general practitioners, hospitals and drug manufacturing houses, an official committee composed of recognized medical authorities, acting under departmental ægis, has compiled a list of drugs the importation of which is considered unnecessary. It is suggested that drugs on this list should be used with the strictest economy while the War continues. The purpose of this recommendation is to support the Government policy to cease using cargo space and foreign currency to import drugs which are not essential in war-time or for which substitutes can be obtained at home.

The official committee suggests substitutes which are considered suitable for some of the drugs included in the list. Instead of aconite, it is suggested that benzocaine should be used for local application; since the sources of aconite are Germany, Switzerland and France, importation is not possible. The note against Balsam of Tolu (a South American product) is that no substitute is necessary. With regard to buchu leaves, cubebs, balsam cophiba and sandalwood oil, it is suggested that one or other of the following substitutes should be used: sulphanilamide, hexamine, mandelic acid, sodium benzoate, scoparium. In place of the Mozambique drug, calumba root, the use of quassia is indicated. As a substitute for cantharides, the sources of which are Spain, Russia, Hungary and China, mustard is suggested.

Small production of English caraway seed is available; in the past our main supplies have come from Holland or Germany; home production should be encouraged but, in the meantime, aniseed is suggested as a substitute. The importation of cassia from China is unnecessary. Instead of coriander seed, derived mainly from Morocco and Russia, the use of cardamons is proposed, supplies being plentiful. Male fern and carbon tetrachloride are suggested as substitutes for cusso. The therapeutic value of fig is said to be doubtful.

Synthetic analgesics are recommended to replace gelsemium, an American importation. Another American drug, hamamelis, might be replaced by tannic acid. Instead of Mexican jalap and its resin, the use of colocynth, stocks of which are of fair size, is proposed. Tannic acid is suggested in place of krameria, and kaolin in place of linseed for poultices. Lobelia herb, which comes from the eastern United States, may be replaced by nikethamide or leptazol, or by stramonium, should the home-produced drug be available. As substitutes for pelletierine tannate, which is derived from Mediterranean countries, male fern and carbon tetrachloride are recommended. Indian podophyllum is suggested instead of the American root, and isphagula instead of psyllium seed. Salicin may be replaced by sodium salicylate, scammony by Indian podophyllum and senega root by iodides, ammonium bicarbonate and ammonium chloride.

PROGRESS IN SEISMOLOGY

THE forty-fifth report of the British Association committee on seismological investigations was to have been presented at the meeting to have been held at Reading. This meeting was cancelled, but the report in question is now in print.

In spite of the War, seismology has made progress in Great Britain during the year. The committee has Milne-Shaw seismographs on loan at Oxford (2), Cape Town (2), Edinburgh and Perth (West Australia). All these are in operation, except one at Oxford. There is also a Jagger shock recorder in operation at Comrie. The seismograph (Milne-Shaw No. 63) and seconds regulator clock sent to Fiji last year have not yet been erected. They are awaiting the construction of the projected meteorological station at Suva, which will most likely be a matter of only a few months. A complete new recording outfit supplied with two motors and drums, one spring-driven and the other with an electric drive, has been sent to Entebbe. The original recording units sent out in 1923 have also been overhauled and repaired in West Bromwich and returned. New mirrors have been sent to several Indian stations.

Miss E. F. Bellamy is carrying on with the work at Oxford with the part-time assistance of Mr. Cook, in the absence of Mr. J. S. Hughes and Prof. H. H. Plaskett. The old system of co-ordinates has been used in the preparation of the International Seismological Summary, since no decision was taken at Washington last September on the adoption of geocentric co-ordinates. Very little material is now being received for the Summary. Last September the Milne-Shaw N-S seismograph at Oxford was dismantled and stored for safety, the seismological basement being well shored up and protected. During the year, Mr. R. E. Ockenden has again made a valuable gift to the John Milne Library, and the British Association Seismological Committee has been responsible for publishing new seismological tables by Dr. H. Jeffreys and Dr. K. E. Bullen.

The Accra earthquake of June 22, 1939, has been investigated, all the macroseismic work being conducted by the Geological Survey of the Gold Coast under the direction of Dr. N. R. Junner. The focus was found to have been below a very steep slope in the bed of the ocean to the south of Accra, and it is hoped that full details will be published in due course.

Dr. A. T. Dollar is continuing the work on British earthquakes from the Geology Department of the University of Glasgow. Further matter has been obtained for the catalogue of British earthquakes for the period January 1, 1916–October 1, 1935, and 27 more permanent voluntary observers have been added to the 321 previously on the list, though Channel Islands observers have been lost owing to evacuation. Since July 1, 1939, the following British earthquakes have been investigated: July 18, 1939, Manchester; February 2–3, 1940, Stirling; March 18, 1940, Birmingham; and a mine shake, July 5, 1939, Bargoed, Glamorgan. Information is now being collected concerning the earthquakes of July 9, 1940, North Argyllshire, July 14–15, 1940, West Midlands, and July 16, 1940, Stirlingshire.

WHEAT DIET AND LEPROSY

In a valuable paper published recently, Drs. R. G. Cochrane and M. Paulraj, and Miss M. D. Salmond (*Indian J. Med. Res.*, 27, 4 ; 1940) discuss the results of their treatment of certain symptoms in leprosy by the administration of a wheat diet. The experiments were carried out at the Lady Willingdon Leper Settlement during the last two years.

The authors point out that it has been recognized since the publication of Jonathan Hutchinson's book on leprosy and fish-eating in the latter part of the nineteenth century that there is a strong possibility that the causative factors of the disease may be dietary. However, most workers are of the opinion that the spread of leprosy in individual communities is attributable more to contact with open cases than to nutritional deficiencies. The authors have been working on the problem from the dietary aspect but as yet their findings are in general still inconclusive, and therefore they confine their report to a single observation regarding the value of a wheat diet in the relief of painful neuritis and certain joint pains. The experiments were carried out to test the suggestion that excessive consumption of carbohydrates may be responsible for metabolic imbalance. Wheat was therefore substituted for rice in the diet of the patients.

Thirty-seven cases were examined, and in every case where the wheat diet was consumed for three months or more, there was either complete relief or substantial alleviation of the painful symptoms. One curious difficulty experienced during the course of the work was the great reluctance of the Indian patients to take wheat instead of rice. In some cases, even when relief had been obtained from the wheat diet, the patients insisted on returning to rice. For adults 21 ounces, and for children 12 ounces, were the amounts of wheat administered each day. Throughout the investigation, the patients continued to receive the standard treatment of the institution for leprosy.

Analysis of the results shows that of patients treated for bone pain, 85·7 per cent showed complete relief, and 14·3 per cent partial relief. The corresponding figures for nerve pain were 69·5 and 30·5 per cent. The authors point out that whereas there was a constant improvement in nerve pain, there was no corresponding improvement in the leprosy condition. In reply to the possible objection that there were no controls, they state that as none of the patients had responded to palliative treatment beforehand, they automatically constituted controls themselves.

In conclusion, the authors state that their experiments show that the new method is worthy of trial where previous remedies have failed. It should be tried as a therapeutic measure before resorting to operative methods for painful neuritis, except in cases where there is a marked swelling of the nerve-sheath and threatened abscess-formation. The method, in addition to the hydnocarpus treatment, does not appear to hasten the disappearance of *Mycobacterium lepræ* from the skin and mucous membrane of the nose.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND

The fourteenth annual report of the Department of Scientific and Industrial Research, New Zealand*, includes the Minister's statement together with the report of the secretary, and the reports of the several research committees of the Council as well as reports on research work at the agricultural colleges, the Physical Testing Laboratory, the Dominion Laboratory, the Geological Survey Branch, the Dominion Observatory, the Magnetic Observatory and Meteorological Branch. Immediately on the outbreak of war, the resources of the Department were placed at the disposal of the defence authorities, the Ministry of Supply, and the various controllers operating thereunder.

Investigations relating to problems of supply, increase of production and conservation of natural resources were initiated by the Department itself. The campaign against plant diseases and insect pests has been intensified and in view of the importance of soil survey to land development, those in progress are being accelerated as much as possible and a survey of the soil of the North Island is already well advanced.

A new industry which is now well on the way to successful establishment is the production of linen fibre. Prior to the outbreak of war, investigations, both local and overseas, into the possibilities of establishing such an industry had been made with very encouraging results. Trial planting of selective varieties of linen flaxes in Canterbury showed that fibre of the desired quality could be successfully grown and would at the same time provide for a profitable diversification of farming practice. Further developments in the war cut off the supplies of linen fibre formerly obtained by Britain from European sources, and an appeal was made to the Dominions to accelerate production of linen flax as rapidly as possible to help to meet the deficiency.

The Department is giving special attention to methods of storing fruit and dairy produce designed to meet emergency conditions. The research carried out on the cold storage of fruit has covered refrigerated gas storage of apples, the effect of fertilizers on storage quality, and wastage in citrus fruits. A programme of orchard storage experiments designed to give information to enable the best methods of non-refrigerative storage to be adopted, is also planned, as well as the erection of a semi-commercial scale refrigerated gas store. Close liaison has been established with the Department of Industries and Commerce through an inter-departmental technical committee upon which both departments are represented with the view of examining New Zealand's local resources of minerals and all other raw materials with the view of supplying substitutes for those materials which are more difficult to obtain or are unavailable as a result of the War.

---

* New Zealand. Fourteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 100. (Wellington: Government Printer, 1940.) 2*s*.

The Geological Survey has carried out quantitative surveys of deposits of such minerals as bentonite, manganese, chromite, clays, refractories, oil shale, sulphur and coal which are of special industrial importance at the present time. The Survey has also actively assisted the Mines Department and various companies engaged in the exploration of the potential petroliferous areas of the Dominion.

The detailed survey of New Zealand's coal resources is being further extended and the necessary chemical investigations have been carried out in the Dominion Laboratory, which has also undertaken special work in relation to the gas storage of fruit as well as investigations of substitute fuels for use in emergency. The Research Associations for Leather and Shoe Manufacturing and the Wool Manufacturing Industries have given special attention to maintaining the standard of quality of the products of these industries. Through these associations very great help has been rendered in technical problems arising from the greatly increased demands to meet Government contracts as well as supplying the ordinary requirements of the trade. On the outbreak of war, the Meteorological Office and Apia Observatory were immediately transferred to the control of the Air Department for the period of the War so that the service supplied by this office should be primarily available to the defence forces. The Department has also compiled a register of the scientific personnel of New Zealand and the detailed information thus obtained has already been of real practical use.

The Dairy Research Institute has continued its research in cheese-making, particularly on the determination of methods of preventing the failure of cheese starters in factories as well as on butter-making, including the keeping properties of butter and the hardness of butter. The Plant Research Bureau has continued its work on the development of pure and smut-free seed-wheat and has also made important contributions to the establishment of the linen flax industry. The Plant Diseases Division has been concerned with work on the diseases of cereals, Brassica, grass and tomatoes, etc., as well as seed disinfectants, copper sprays, both in the field and in glass-houses. The results obtained with copper sprays indicate that so far none of the Bordeaux substitutes is equal to Bordeaux mixture in disease control when compared on the basis of equal concentrations of copper. Excellent control of tomato leaf mould has been obtained with Shirlan *AG* in glasshouse tests under commercial conditions. The Plant Chemistry Laboratory has been responsible for work on the cyanogenetic glucoside of white clover as well as on plant hormones. Fruit research of the Department has covered fertilizer experiments on apples, the biological control of woolly aphis, chemical control of various insect pests such as red mite, leaf hopper, and bronze beetle, biological studies of mouldy core of apples and spraying experiments. Tobacco research has also included experimental work with fertilizers, investigations on mosaic and on collar rot disease, on the damping-off fungi, and on the effect of steam sterilization of the soil on seed germination.

FORTHCOMING EVENTS

Thursday, October 17

Institute of Fuel (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.15 p.m.—Mr. W. M. Selvey: Presidential Address.

Friday, October 18

North-East Coast Institution of Engineers and Shipbuilders (in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne), at 6 p.m.—Annual General Meeting. Mr. W. A. Woodeson: Presidential Address.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Teacher of Science, Mathematics and Technical Drawing at the County Technical School, Halesowen—The Director of Education, Education Office, County Buildings, Worcester (October 17).

Head of the Building Department and Lecturer in Civil Engineering—The Secretary, Technical College, Sunderland (October 21).

Lecturer in Electrical Engineering and Physics—The Clerk to the Committee of Management, Technical College, Shrewsbury.

Wireless Engineer for the Posts and Telegraphs Department, Gold Coast—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/5976).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Home Security. Air Raid Precautions Memorandum No. 16: Emergency Protection in Factories. Pp. 8. (London: H.M. Stationery Office.) 1*d*. net. [259

Medical Research Council. Bulletin of War Medicine. No. 1, September. Pp. iv+64. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [309

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 19: The Effect of the Inhibition of Respiration and Assimilation of the Diatom *Ditylum Brightwelli* (West). By Dr. D. Bhatia. Pp. 245–259. 1*s*. 3*d*. Vol. 60, Part 3, No. 20: The Structure and Behaviour of the Chromosomes of the Sheep during Mitosis and Meiosis. By I. A. Ahmed. Pp. 260–270. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [309

War-Time Problems: Training Industrial Workers. Pp. 12. (London: National Institute of Industrial Psychology.) 3*d*. [309

Ministry of Health. Memorandum [illegible] for the Control of Mosquito Nuisances in Great Britain. By [illegible] A. Sinton and P. G. Shute. (Memo. 238 Med.) Pp. 30. (Lon[illegible] M. Stationery Office.) 6*d*. net. [210

Other Countries

Indian Lac Research Institute. Annual Report for the Financial Year 1939–40. Pp. ii+38. Bulletin No. 42: The Viscosity of Shellac-Urea Solutions. By G. N. Bhattacharya. Pp. 14. 3 annas. (Namkum: Indian Lac Research Institute.) [259

Report on the Department of Agriculture, St. Lucia, 1939. Pp. ii+38. (St. Lucia: Government Printing Office.) 6*d*. [110

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 188: Application of the Similarity Theory of Turbulence to the Flow through a Straight Pipe of Annular Cross-Section. By Susumu Tomotika, Kō Tamada and Yukimasa Saito. Pp. 27–60. 45 sen. No. 189: Note on the Application of the Momentum Transport Theory to the Turbulent Flow through a Straight Pipe of Annular Cross-Section. By Susumu Tomotika and Hazimu Umemoto. Pp. 61–76. 30 sen. No. 190: Application of the Vorticity Transport Theory to the Turbulent Flow through a Straight Pipe of Annular Cross-Section. By Susumu Tomotika and Kō Tamada. Pp. 77–96. 35 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [110

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1940. Pp. 40. (Wellington: Government Printer.) 1*s*. [310

Union of South Africa: Department of Mines. The Mineral Resources of the Union of South Africa. Pp. 544. (Pretoria: Government Printer.) 5*s*. [410

Catalogues

Dunns Seed Wheats, 1940. Pp. 12. (Salisbury: Dunns Farm Seeds, Ltd.)

Editorial & Publishing Offices:
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 19, 1940 No. 3703

FUNDAMENTALS IN POST-WAR RECONSTRUCTION

HOWEVER great the horror and detestation with which the aims and methods of Nazi Germany may be viewed, it must not be forgotten that they have sufficed to raise a crushed and despondent people to take a place once more among the Great Powers, even though it has ceased to play any part in affairs beyond that of a powerful and firmly welded instrument designed for and directed solely to domination. Whereas Great Britain and her allies hold fast to a faith rooted in belief in the essential dignity of mankind, a dignity which can attain full stature only in a world in which freedom and justice are the guiding principles, it must constantly be kept in mind that, over against that ideal there stands another, an ideal of service and self-sacrifice in the interests of the group or State, which is, if anything, even more compelling and no less inspiring of devotion in its votaries than that to which we give allegiance. If we believe that the ideals of democracy and the cause of humanity will prevail in the long run over the narrower and cruder aims of a restrictive nationalism, and the totalitarian State which is bent on aggression and domination by force, it is incumbent upon us to justify that faith by showing that it has a more certain foundation than wishful thinking. On this the verdict of science claims to be heard.

Magna est veritas et praevalebit. But if truth, that is the reality of things, is to prevail in post-War reconstruction, where does it reside? Faith in the ultimate triumph of truth exacts that the settlement and adjustments that are to come should be in harmony with it; and the lasting character of the peace which will be made and the opportunities peace will afford for the advancement of mankind will stand in direct relation to the clarity we attain in our vision of its principles and essential nature. In Germany, in the last seven years, by the aid of the crudities and unwarranted interpretations of racial theory and the suppression of freedom of thought and research, the resources of science and its methods have been harnessed to the production of a certain type of mentality and a society wholly subservient and adapted to the creed of an aggressive, violently national, totalitarian State. Is it in this direction that truth lies?

Granting the difference in aim of a society that desires peace and the advancement of mankind, is the regimentation of the individual inseparable from the application of scientific truths to the problems of the well-being of the peoples of the future? In other words, is the democratic ideal of the freedom of the individual in thought and action compatible with the scientifically planned economy which, so far as can be seen at present, post-War conditions will demand as an essential condition of the survival of civilization and the rescue of large masses of the world's population from the effects of abject destitution? Democracy is notoriously slow to act, and in its anxiety to compromise in the interests of individual rights, not infrequently muddled in its decisions. Guidance of such a society along the paths to its welfare indicated by the results of scientific research is apt to enlarge the powers of the bureaucrat. It must seem, therefore, that one of the first problems to be resolved in post-War society, assuming the survival of the democratic ideal, will be to reconcile the freedom of choice of the individual with the application of scientific principles which, it can be shown, are essential to the well-being of some or all the members of a given community. Obviously one solution lies in education, and the more widely it is spread, and the greater its continuity, the more readily will the conflict be resolved.

Such questions, however, are a matter of machinery and leave the main principle untouched. In the interval between the two world wars of 1914–18 and of 1939, the course of events in world politics and economics was such as to lead many to think that the rapid expansion in the material development of the twentieth century, in which science has played a preponderant part, has masked a very real check in the intellectual and moral development of mankind. The optimism as to the capability of mankind for continuous development, which was characteristic of the nineteenth century, gave way to a pessimism which regarded civilization, at least in its Western form, as on the verge of dissolution. Such a pessimistic view, however, is unscientific and lacking in perspective. The more intensive the study of man and of human society, and the more precise the methods applied to these studies, the more clearly does it become apparent that, on a long view, the story of man physically, mentally, morally and socially has been on the whole one of continuous advance. To say this is to ignore neither the fact that advance in certain characters is now less readily discernible than in others, or that in specific instances great civilizations have risen and after a period of dominance have fallen into decay.

If it be accepted as demonstrable truth that, just as man, like other members of the animal kingdom, is the product of an evolutionary process, so also the social and cultural structure, which he has devised as the setting and means for the existence of the individual and the perpetuation of the race, the joint product of his brain and the necessities, physical and other, of his organism, is also the outcome of a development which may be regarded as closely analogous to the evolutionary process of the organic world. Without entering into details of the argument, it may be taken that recent application of the methods of research in social anthropology to problems of administration among backward peoples, more especially in Africa, has shown that if acute unrest and dislocation in the social organism is to be avoided, any attempt to promote the well-being of the people, whether by the introduction of a more advanced and efficient system of government or by raising the general standards in mode of life, must be adapted to the cultural stage of the community and must be in harmony with what, it might be anticipated, would be the natural trend of social and cultural development.

In the history of human society, progress in civilization would appear on broad lines to be largely dependent on two factors. It is rooted in the institution of the family, the most stable and, on the whole, the most effective agent for the early training of individual character; and secondly, it depends upon the degree to which the community, the greater unit within which the family exists, reproduces the conditions of the lesser unit in a consciousness of unity and the peaceful harmony with which its members are prepared to co-operate with one another. Further, it is a matter of observation as well as of historical record that the more extended the social unit in which conditions comparable to the family prevail—clan, tribe, people or nation—the greater the opportunities for the growth and development of the individual in conditions of social, political and economic tranquillity. That there have been exceptions by no means invalidates an argument which can be illustrated by reference to a line of development which has culminated in the British Empire, the movement towards unity of the two Americas, and would now seem to be at the point of being carried further in the approach to one another under stress of the two greatest English-speaking peoples of the world, the United States and Great Britain, with its American possessions and Canada.

In so far as these principles or rather trends in social and political development throw any light on the fundamentals of post-War settlement, they would appear to point to the necessity for continuous endeavour to create larger and even larger unities, which both internally and externally would work for the preservation of peace by eliminating inter-group political, social, and economic competition and rivalry. The League of Nations was an attempt to create such a unity, but it failed. The post-War settlement which followed the War of 1914–18, in the attempt to restore the *status quo ante bellum*, erred in stressing the small group, and by fostering rights of self-determination opened the way to racial and national self-assertion and rivalry. Contrast its political failure with its success in the fields of scientific research, social reform and intellectual co-operation, in which national and racial barriers were ignored.

The League might have been saved from a

second mistake had greater heed been given to the cultural traditions of the peoples whom it was sought to include in a close bond of union. It brought within its fold not only nations of very varied cultural history in northern, western, eastern and southern Europe, as well as South Americans long removed from European tradition, but also peoples at varying stages of cultural development. As a result, when Abyssinia was attacked, a State that many regarded as semi-barbarous, the League showed itself impotent. Unity of action was unattainable. The failure up to the present to secure co-operative effort in India is held by many to be due to a failure to appreciate the difficulty of applying advanced political ideas to a situation conditioned by the varied stages of social development of the population, which have not in any instance yet attained a point at which the democratic ideal can be fully grasped.

So far as a post-War world is concerned, the first lesson of the past history of social development appears to be that we must not look for any return to the *status quo*. The future line of development lies in the direction of the formation of larger and larger political and social entities, among whom peace will be secured by co-operation, good will and a common interest in the advancement of humanity, as well as the elimination of political and economic rivalries. At the same time, regard must be paid not only to differences of cultural tradition, for these indeed will make a useful contribution to the common stock of ideas, but also to differences in the stage of cultural advancement, lest incompatibles be held in too close a bond of union which friction and lack of understanding will disrupt. Too frequently the impact of two widely diverse cultures has brought about friction, disintegration and retarded development. Hence the difficulty which confronts any attempt to form a federated Europe which necessarily must include States of backward peoples, as well as the more advanced. A system of zoning or grouping of compatibles must be devised.

It is evident that, if the trend of development in the future of human society can be determined thus with reasonable probability, the Nazi aim of a dominant Aryan people ruling the subject and inferior races of a united but conquered Europe is retrograde and contrary to the trend of social 'evolution'—a reversion to the medieval conditions of the period of migrations.

On the other hand the democratic ideal does at least allow for that free play of ideas essential to a progress which in the long run will conform to the truth as we see it—a harmony with the evolutionary process.

THE PLAIN MAN AND GOD

God in a World at War

By John Hadham. Pp. 96. (Penguin Special S.73.) (Harmondsworth and New York: Penguin Books, Ltd., 1940.) 6*d*. net.

The object of this little book is not to argue, "but only to state a belief in God in terms which any man can understand". In this it has certainly succeeded, though a belief in God which is understandable is not necessarily credible. Still, unless a belief in God is put in intelligible terms, it is not likely to be effective, even if true. As Mr. Hadham says, "God cannot be made real by the irrelevant accuracies of metaphysics"; and this is all the more the case when these irrelevancies are inaccurate. One of the things from which we are suffering to-day is "that all the conventional descriptions of God were written by men who held totally different views of the world, of human society, and of the nature of the individual, from that which we now hold." These descriptions were valid enough at the time they were written, but the permanence of such validity was dependent on the permanence of the views in terms of which they were made; and the terms are now quite obsolete and not so much incredible as meaningless.

Of course the trouble is that when you make a profound idea understandable you may sacrifice its profundity. For example, in his desire to make it clear that God is personal, Mr. Hadham may seem to many to present us with a deity with strong resemblances to Mr. Henry Ford, or perhaps to Mr. Gladstone. It may be true that "God is a person, and is best described and thought of by the ordinary person in purely personal terms"; but it will not do to regard God as a magnified and non-natural man. That is almost worse than theological mumbo-jumbo. Even the ordinary man cannot be relieved of the painful necessity of asking himself, when he is told that God is a person, what do I mean by a person ? Mr. Hadham is not helpful here because he rather condones the popular view that metaphysics is a mystery, and not just the pursuing of ordinary questions to their ultimate limits. If a man asks himself what a person is, he may end by regarding personality (as the Oriental religions do) as a limitation rather than as a goal. Religion may even consist in trying to transcend or pass beyond personal existence with its desires and fears. Is not the *ego* a limitation, a prison, a barrier dividing us from God ? Even Christian mystics seem to have suggested this. If this is so, is Mr. Hadham really on right lines with his activist, common-sense religion ? It is of course far better than the "churchianity" he treats with such vitriolic contempt, but that, surely, is not to say much.

But the virtue of this book consists in the fact that it does supply the plain man with a version of Christianity which he can at any rate understand and endeavour to practise. Most people who lapse for good causes or bad from organized religion become for practical purposes secularists. But there is no reason why they should, if they read this able, sincere, and highly readable book.

J. C. H.

THE PHYSIOLOGY OF REPRODUCTION

Recent Advances in Sex and Reproductive Physiology

By Dr. J. M. Robson. Second edition. Pp. xiii + 329. (London : J. and A. Churchill, Ltd., 1940.) 15*s*.

IT is six years since the first edition of Dr. Robson's "Recent Advances" was published, and in the interval great progress has been made in sexual physiology and in particular in the study of the sex hormones. The principal results of the newer work have been successfully incorporated in the second edition, and the author is to be congratulated on having achieved a not very easy task. In reviewing the first edition it was pointed out that the title was somewhat misleading since the work dealt almost exclusively with the sexual and reproductive phenomena of the female organism, omitting the work done upon the male. This criticism has now been met, for not only has a new chapter been added on the male hormone and other androgens, but also such subjects as "cycle changes in the male", the "assay of androgens", and other contributions to the physiology of the male sex have been incorporated in the appropriate parts of the book. Moreover, there are additional chapters on the chemistry of the hormones and on the methods used in their standardization and the determination of their activity.

The least satisfactory chapter in the book is probably that on the maintenance of pregnancy and the initiation of parturition, but this is not due so much to the author's treatment as to the inherent difficulties of the subject, resulting from the apparently contradictory evidence and the great amount of species variation. Nevertheless, although recognizing the antagonistic action of oxytocin and progesterone as shown by the fact that uterine response to the former is decreased by the presence of the latter, the author fails to give full weight to the evidence on the point as presented by Dr. Knaus in his work on "Periodic Fertility and Sterility", a book which is referred to in another chapter.

In a chapter on the function of the pituitary and its relation to the gonads, the neural factors regulating the cycle are dealt with rather inadequately. The work on the "Hypothalamus and Central Levels of Autonomic Function", recently issued by the Association for Research in Nervous and Mental Diseases, no doubt appeared too late for consultation, but only a very few of the papers quoted in the articles by Drs. Brooks, Bard, and Uotila, are referred to by Dr. Robson. This is unfortunate, as the recognition of the important part played by exteroceptive factors in sexual periodicity is among the recent advances of generative physiology. It is true that some of the most beautiful examples of such phenomena are to be found among birds and lower vertebrates and that Dr. Robson's work confines itself to mammals. Nevertheless, with mammals of certain species the evidence of neural control is very evident, but only a few examples of this are cited. Dr. Harris's work on the production of pseudo-pregnancy in the rat (an animal which ovulates spontaneously) as a result of electrical stimuli is omitted, and there is no account of the numerous experiments by different investigators on ovulation in the rabbit as a result of stimulating substances acting on the pituitary or on the hypothalamus. The statement that electrical stimulation of the cervical sympathetic ganglia produced ovulation is now known to be erroneous, as has already been pointed out in several papers. It is to be hoped that greater prominence will be given to the subject of neural control in the third edition, which will be doubtless called for in a few years.

F. H. A. Marshall.

ASIATIC YAMS

An Account of the Genus Dioscorea in the East

(Annals of the Royal Botanic Garden, Calcutta, Vol. 14.) Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. Pp. viii+ 211–528+ xx+ plates 86–150. (Alipore: Bengal Government Press, 1939.) 67 rupees; £5.

YAMS must have been one of the foods of primitive man, and in their wild state they still form one of the chief components in the diet of jungle tribes; indeed, in times of failing rainfall and consequent scarcity, they rise to a prime importance for the survival of individuals in remote tracts. These tubers are commonly found at a considerable depth underground, sometimes as much as five feet, and are often protected against the depredations of wild animals, principally pigs, by thorny growth above the tubers themselves. Considerable labour is demanded for their extraction, especially in times of duress when drought has hardened the soil. The wild man's tools are of poor quality, and it is at such times that the curse of Adam lies heavy on the untutored savage.

At what stage in this evolution, and by what chain of circumstances early man began to realize that he could make his life easier and more secure by growing his food artificially, and by what slow degrees he achieved this purpose, is a fascinating, if not very fruitful, subject for speculation. But achieve it he did, and in so doing he improved the quality and quantity of the yield by bettering the conditions under which it was grown, and by conscious or unconscious selection. Was the first step the result of a flash of genius in one man or a slow process growing up by accident? Presumably we shall never know. Under cultivation the size and shape vary very greatly in the same species, as can be seen from plate 125 of this work, where no fewer than 72 different forms of the tubers of *Dioscorea alata* L. are figured.

As is the case with many cultivated plants, it is not possible to state definitely where certain yams, now well known, are truly indigenous, even though it is known in what localities they are growing spontaneously. Some yams have poisonous properties when raw and have to be prepared accordingly before they are fit for human consumption.

The first part of this monograph, dealing with the species which twine to the left, was reviewed in NATURE of January 29, 1938, and a portion of the present part in that of November 25, 1939. In the latter survey it was pointed out that the systematic matter was not yet published. The full part has now been issued, and the whole of this noble contribution to botanical science is available to those interested.

The systematical portion of this part deals entirely with the section Enantiophyllum—the species which twine to the right. It comprises seventy-six species, that is to say, a few more than the sum of all the other sections. In it is included the most important species from the point of view of food material—*Dioscorea alata*, Linn. This yam has been very widely cultivated, not only in the East, but also in Madagascar, many parts of Africa and in the West Indies.

A simple and easily applied key to the species is provided and also keys to the varieties where subdivision calls for them. A full description of every aspect is given for each species, together with complete synonymy and references to literature. The herbarium specimens examined are listed under the subregional scheme adopted by the authors. All this, however, is not the sum total; a comprehensive history of each species is recorded with a discussion of the significance of the vernacular names applied to it; the uses are detailed, with information on cultivation and the preparation of the yams and bulbils for consumption. One feels that the authors have followed up every clue with the pertinacity and acumen of a criminal investigator, bringing to light every fact possible for the compilation of a complete 'dossier' for each species. The resulting production, moreover, is as entertaining to the discerning reader as the pages of a 'thriller'. In short, this monumental achievement can claim to be an exhaustive account of the Dioscoreas of the East, and it seems difficult to believe that anything is left for further investigation.

In the course of their researches the authors have found it necessary to make no fewer than seventy-four new species, one more than had been hitherto published. These have all been described previously in the pages of various journals; the great majority in the *Journal of the Royal Asiatic Society* or in the *Kew Bulletin.*

The sixty excellent drawings (besides three photographic reproductions and three plates of locality maps), are the work of several artists, but nearly one half are from the pencil of the junior author. C. E. C. FISCHER.

A GERMAN ZOOLOGY

Handbuch der Zoologie
Eine Naturgeschichte der Stamme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Band 3: Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lieferung 12. Pp. 160. 22 gold marks. Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lieferung 13. Pp. 128. 18 gold marks. (Berlin: Walter de Gruyter und Co., 1939.)

THESE are the last two parts of this now well-known "Handbuch" to be received in Great Britain and it seems likely that no more will be received for some time.

The first is illustrated with 288 figures, only three of which are original, but they are well chosen and well reproduced so that they form a useful collection. The text continues the account of the Araneæ by Prof. U. Gerhardt and Dr. A. Kästner, and concludes the description of the embryology already commenced in the preceding part. It passes on to deal with the ecology, web spinning, reproductive phenomena, stridulation and moulting. Two pages are devoted to a discussion of the phylogeny before passing on to the classification and systematic review which occupies 78½ pages. The last 8½ pages are devoted to the bibliography, and so this part terminates the account of the Araneæ. The Liphistiidæ are regarded as the oldest of the spiders.

In the second part, 29 of the 120 illustrations are original, and the idea of illustrating individual species by a series of photographs of good specimens rather than by drawings has proved a most successful one. The first 3½ pages finish the bibliography of Prof. C. J. Cori's account of the Phoronidea, and the remainder of the part, with the exception of 4 pages of index at the end, is devoted to Dr. J. Gerhard Helmcke's treatment of the Brachiopoda. It includes a description of the shell and skeleton and of the anatomy, histology and development of the group. Short accounts of the physiology and ecology precede a somewhat longer one of the geographical distribution, particularly in relation to the ocean currents. As in other groups, the account ends with the systematics and a list of the literature. For conciseness and compactness of treatment this part on the Brachiopoda might well have served as a model for the accounts of some of the previous groups, which tended to be prolix and discursive.

It is no small praise to the authors, editors and publishers of these two parts to say that they worthily maintain the standard of the "Handbuch".

AGRICULTURAL INDUSTRIES

The Agricultural Industries
By Prof. Deane W. Malott and Boyce F. Martin. Pp. viii+483. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 26*s*.

IN the early agricultural systems the production and processing of food, drink and clothing was carried out within the farmer's family. It is a feature of a developed agriculture that the cultivator finds full-time occupation on the land, handing over his product to form the starting point of associated industries of ever-increasing extent and complexity. The United States offers an extensive field for the study of the economic and technical problems which these agricultural industries present; for in that country the manufacturing and processing industries based on agricultural raw materials account for no less than 15 per cent of the total industrial output and employ nearly a million people.

The basis of the book is a course of instruction in the agricultural industries given by the authors at the Harvard Business School, and a great deal of supplementary information has been supplied from the many trade experts whom the authors have consulted.

A systematic treatment is adopted. Each of the main industries forms the subject of a lengthy chapter. The types of raw material and methods of production are first dealt with. Then assembly, transport and marketing organization are described and discussed. The authors pass on to the financing and business organization of the industry, and set out the aims and results of the legislation that has been imposed on almost all branches of agricultural production and marketing to meet the economic changes of the past few years. A critical appraisal of the problems of the industry concludes each chapter.

The first section deals with the dairy industry, for the cash receipts from milk by United States farmers are greater than from any other agricultural commodity, and more than three times as large as from wheat. The struggle between producers and distributors around the question of the milk price, with the ultimate adoption of control, has followed the course familiar to English readers. Next comes an account of the livestock industry; the historical sections dealing with the development of livestock farming and the meat packing industry being particularly interesting. Chapter iv is devoted to cotton, and the efforts made by the Government to control surpluses and institute orderly marketing are set out in tabular form covering the period from 1929, when the price decline of American cotton became really serious, until 1939. Occasionally, as in 1937, the bounty of Nature outweighed all restrictive schemes and threatened to bring confusion to the industry.

The extent of the sugar industry in the United States is sometimes overlooked in Europe. The fact is that the output of beet sugar alone is more than twice that of Great Britain, to say nothing of a considerable production of cane sugar. The organization of this industry is discussed in Chapter vi.

Other chapters deal with tobacco and wool. In their concluding section, discussing the relationship of the problems of the farm to those of the agricultural industries, the authors stress the need for grappling with the problems of surpluses, and look to the development of new industries based on new crops to take the place of redundant acres of the older ones. At the same time the processing trades should search for new outlets for the standard crops.

ARCHÆOLOGY IN THE EASTERN MEDITERRANEAN

The Annual of the British School at Athens No. 37, Session 1936–37, Papers presented to Prof. J. L. Myres in honour of his 70th Birthday. Pp. x+286+31 plates. (London: Macmillan and Co., Ltd., 1940.) 42*s*. net.

It is a striking tribute to the work and personality of John Linton Myres that the contents of the thirty-seventh issue of the Annual of the British School of Archæology at Athens consists, not as is usual, of records of research work of members of the School in the year under review, but of a number of papers presented to him in honour of his seventieth birthday by fellow workers in the field of the archæology and early history of the Eastern Mediterranean. A larger number of friends and colleagues, of whom a list is given, have contributed towards the cost of publication. It is appropriate that the British School should delight to honour one who is chairman of its Committee of Management, has been a staunch supporter of its work throughout the greater part of its existence, and is one of its students of longest standing. There will be many who will regret that the circumstances have precluded the inclusion of a like tribute from those whose province lies in other fields of learning and inquiry in which Prof. Myres has achieved an eminence no less worthy of commemoration than his archæological studies in the Eastern Mediterranean.

The list of contributors, needless to say, includes many distinguished names, of whom a few only can be mentioned here. Dr. C. W. Blegen reviews the evidence of the excavations of the expedition of the University of Cincinnati, 1932–38, on the site of Troy in its bearing upon the dating of the various settlements and their contacts with the Early, Middle and Late Bronze Age in the Ægean. An impromptu lecture by Prof. A. W. Brøgger, delivered while on a tour in the *Cairo City* in 1939, on "The Vikings of the Mediterranean and the Vikings of the North", dealing with the cultural influence of sea-power, so impressed its audience as to achieve here a well-deserved permanent record. Prof. V. Gordon Childe also deals with a field which he has made peculiarly his own in "Neolithic Blackware in Greece and on the Danube". An interesting and pertinent topic is examined by Prof. R. M. Dawkins, who traces the process of tradition in Greece in so far as it affects legends dealing with such supernatural happenings as no one is likely to regard as true. An interesting communication by Dr. P. Diaios, which is of added importance for its bearing upon ritualistic and cultural relations, describes an iron age painted vase in the Cyprus Museum, the product of illicit excavation but saved for archæological science, the decoration of which, a ritual of drinking through a siphon, points to a connexion with Syria.

The wide range of interest covered by other papers to which detailed reference cannot be made in a brief review may be suggested by the fact that they extend from western Europe (Prof. H. J. Fleure on the rough stone monument) to Palestine (Prof. D. A. E. Garrod on decorated mesolithic skeletons), and the Anatolian Plateau (Dr. H. Z. Koşay on excavations of the Turkish Historical Society in the copper age levels of Alaca-Höyük).

ALLOYS OF IRON AND CHROMIUM

The Alloys of Iron and Chromium
Vol. 2: High-Chromium Alloys. By A. B. Kinzel and Russell Franks. (Alloys of Iron Research: Monograph Series.) Pp. xv+559. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 40s.

THE Alloys of Iron Monographs, arranged by the Engineering Foundation of the United States, constitute a valuable series. The alloys of iron and chromium have taken up two volumes; volume 1, by Kinzel and Crafts, dealt with those alloys containing less than 10 per cent of chromium, and now volume 2, by Kinzel and Franks, deals with those alloys containing more than 10 per cent of chromium. The volumes are claimed to be a review and summary of published information and available unpublished data. A careful study of both volumes shows that the work has been well done, and a service of the first order rendered to ferrous metallurgy. The scientific and technical literature covering this field is so extensive now that for those who have not grown up with the subject the systematic study and analysis of available data which the authors have achieved is most valuable.

The investigation and technical exploitation of the iron-chromium series has led to the availability of a very valuable series of rust-, acid- and heat-resisting steels, which have greatly assisted modern engineering developments in many widely dissimilar fields. The explanation of this great achievement is that the addition of a sufficient amount of chromium to iron confers upon the iron the property of producing spontaneously upon its surface a passive and resistant film as a result of contact with the atmosphere or with certain aqueous environments. Such passive films, if mechanically damaged, are self-repairing. The quality of resistance of the film is advantageously affected by increasing the chromium content, and as regards quite a wide range of corroding media, by the addition of other elements, such as nickel, molybdenum, tungsten, copper, titanium, etc. It has also been shown, but is not mentioned by the authors, that the corroding medium also, in a very interesting manner, takes a definite part in producing the particular type of film by which it is resisted; as regards the type of film necessary in the case of some corroding media, the formation, whilst taking place with sufficient rapidity for successful technical employment, cannot be regarded as being spontaneously produced. Turning to steels which operate at high temperatures, the oxide film is progressively thickened for a time, and then appears to become stabilized as regards resistance to further thickening. It will be seen that the whole field has presented, and indeed still presents, a great experimental ground for the investigator and also for the practical technologist as regards extended applications.

The authors, in endeavouring to present to the student some account of all published and available work, whilst being largely successful in that object, have almost necessarily given space to both technically interesting and technically uninteresting alloys, and it would have been an added value to the volume if indication had been given in a more definite manner of the extent two hich different alloys had found their particular niche in wide industrial application.

For certain data, fundamental to all ranges of the iron-chromium alloys, it will be necessary to refer to volume 1 (Kinzel and Crafts) which, although directed particularly to a study of the low-chromium alloys, deals with such aspects as the history of the chromium steels, the preparation and properties of chromium metal and ferrochromium, the constitution of the iron-chromium alloys and the general effects of chromium in iron and steel. In the present volume, after referring briefly to the metallurgical fundamentals of stainless steels, the authors describe the melting of the high-chromium steels and discuss the methods which have been developed to overcome the particular problems which arise in the process, owing to the high affinity of molten chromium for carbon. In the subsequent chapters, the fabrication and properties of the various types of high chromium steel and cast iron, and the effect of alloying additions are dealt with systematically, including the extremely important rich chromium-nickel-iron alloys, and the less important chromium-manganese-iron and chromium-aluminium-iron alloys. The work is principally a correlated summary of published data, rather than an expression of the authors' personal and critical findings.

On page 86, under the heading "Effect of Tungsten", we find the statement: "Steel containing 0·12 per cent maximum carbon, 12 to 14 per cent chromium, and 2·5 to 3·5 per cent tungsten, has been proposed for oil cracking service. This material is said to have higher useful strength at elevated temperatures than similar material containing no tungsten, but no data are available". It seems somewhat strange that the authors should have overlooked the following data given in Thum's "Book of Stainless Steels" (second edition), pp. 264–265: "the American Iron and Steel Institute has issued a standard type No. 418 for the nominal composition 12 to 15 per cent chromium 0·12 per cent max carbon and 2·5 to 3·5 per cent tungsten. W. J. Teemer, of Allegheny Steel Company, kindly forwards the following physical properties of metal conforming to the above type number (manganese and silicon both under 0·50 per cent)". Thereafter follow data derived from a series of creep and short-time high-temperature tests carried out at temperatures varying between room temperature and 1400° F. On page 90, for Chapter xvi read xv. On page 292 it is interesting to note that an 18/12 steel is recommended for severe deep drawing. One would have expected the 12/12 steel to be recommended.

It is in regard to low-temperature tests that the most serious inaccuracies have been noted; for example, on page 341 reference is made to Izod impact tests carried out at low temperatures by Colbeck and his associates, on a steel containing 0·13 per cent carbon, 17·80 per cent chromium and 7·97 per cent nickel, but no reference to a steel of this analysis can be found in the original paper. Again, on page 342, data are quoted from a paper given by De Haas and Hadfield (*Phil. Trans. Roy. Soc.*, A, 232, 297–332; 1932). The figures quoted are inaccurate, the correct values being as follows:

	Testing temperatures	
	20° C. (70° F.)	−252·8° C. (−423° F.)
M.S. tons/sq. in.	52·4 (117,400 lb.)	119·8 (268,400 lb.)
Y.P. tons/sq. in.	25·9 (58,000 lb.)	55·8 (125,000 lb.)

On page 368, table 113, first line of the third group, for 79·92 read 74·92.

To one deeply interested in the subject it was natural to look to the index to see what the book contained concerning passivity, the passive film, the sigma phase and contact corrosion. It is always a great advantage in a book of reference of this character to have a complete index, and it is therefore surprising that help is not given to locate the relevant information. The passive film theory is dealt with to some extent, but there appears to be no reference to the very curious phenomenon of intermittent passivity.

There is no doubt that this volume will prove a very useful addition to the technical library, and as regards the text, there appears to be very little to which exception can be taken. It is a very big undertaking to handle critically the large number of papers now extant in this field, but, nevertheless, the authors are to be congratulated upon the extent of the success which they have achieved.

There is an excellent bibliography of the subject consisting of more than five hundred references.

W. H. Hatfield.

HYDROCARBONS

(1) Physical Constants of Hydrocarbons

Vol. 2: Cyclanes, Cyclenes, Cyclynes and other Alicyclic Hydrocarbons. By Gustav Egloff. (American Chemical Society, Monograph Series No. 78.) Pp. 605. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 72*s*. net.

(2) Conversion of Petroleum

Production of Motor Fuels by Thermal and Catalytic Processes. By Dr. A. N. Sachanen. Pp. 413. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 36*s*. net.

To the chemist the word hydrocarbon defines a particular group of substances, to the public the equivalent word petroleum signifies motor fuel and motive power. To-day, when the destruction of the oil supplies and reserves of the enemy is the primary object of our bombing raids, it is interesting to reflect on the enormous technical advances in the petroleum industry largely due to the application of scientific research and the extension of scientific knowledge. Probably no industry has done more to encourage research and development than that of petroleum, and it has been richly rewarded. In particular the speed of the development has been amazing.

Whereas in early days straight-run products, that is, selected fractions of a simple distillation, were the rule, at a later stage these were augmented by cracking the higher boiling residues, and to-day thermal and catalytic processes have been brought in both to augment the yield of motor spirit and to give to it a quality which enables the modern engines which use it to produce such amazing speeds in aeroplanes and elsewhere.

(1) Egloff's book is the second volume to appear of a four-volume series in which the physical constants of hydrocarbons are collected. The first was reviewed in Nature of March 23, 1940, and covered the open straight- or branched-chain hydrocarbons; the second deals with the cyclanes or closed-chain compounds, which the author tells

us amount to about one quarter of the total world production of oil. A brief and well-written introduction deals with the nomenclature of alicyclic hydrocarbons, which is in a confused state. The author has set out rules based on the Geneva Nomenclature Conference of Organic Chemistry with his comments, and uses the terms cyclanes, cyclenes and cyclynes for cycloparaffins, olefines and acetylenes respectively.

The tabular text is broken up into sections listed in the table of contents ; each substance has its formula clearly set out and references are given to the original literature for each physical constant.

(2) Sachanen's monograph, which is likewise of trans-Atlantic origin, is a timely exposition of the principles and methods of the production of high-octane fuels. The subject is so extensive that the scope of the book has had to be limited, and consideration of the vast patent literature has been omitted as well as any account of the historical development.

Whilst thermal cracking remains the most important process in the conversion of crude oil into motor spirit, the newer processes are coming more and more to the front, including those dealing with refinery gases.

This is a book essentially for the petroleum technologist, and criticism in detail of the author's method of treatment of the problem is best left to a more technical journal. The chemist at large will gather from it the enormous amount of scientific work which lies behind the practical effort that enables us to buy a gallon of reliable petrol for our car.

E. F. Armstrong.

SCIENCE AND PSEUDO-SCIENCE IN POLITICS

Marxism

A Post-Mortem. By Henry Bamford Parkes. Pp. vii+246. (London: George Allen and Unwin, Ltd., 1940.) 7*s.* 6*d.* net.

THIS is a straightforward and readable criticism, written primarily from an American angle. The author describes how history has deviated from the path which Marx marked out for it ; he shows up the dreary unrealities and illogicalities of the Marxian theory of value : he shares, in the main, with the orthodox economists and the neo-socialists, the conviction that extensive economic planning is incompatible with personal freedom, and that only under a free market system, where the consumer is king, can the public be well served with the goods and services of its choice ; and finally he delivers a relatively mild attack upon the metaphysical foundations of Marxism.

Most of this has been said before. The author is perhaps most effective in his historical section, where he is also most concrete. He produces here some facts that are very awkward to assimilate in the orthodox doctrinaire Marxist analysis of contemporary society. Revolutions, for example, have proved themselves to be more at home among peasant than among industrial communities ; and the industrial proletariat and its trade unions have shown markedly conservative tendencies, while the rise of a new middle class has thrown the Marxian class war right out of gear. Further, whatever else may have been accomplished by the professedly Marxist revolution in the Soviet Union, the level of prosperity and the range of personal freedom to be enjoyed there still remain behind that of States like Sweden.

The depressing thing is that there is so little reason to believe that this book will shake the faith of a single Marxist. For Marxism is a faith, and not a hypothesis based upon considered and precise observation of facts ; and the root of the trouble is that social matters are still considered even by eminent men of science (many of them calling themselves Marxists) to be an appropriate sphere for faiths. What is wanted, in fact, is not just a post-mortem on Marxism, but a post-mortem on the whole apparatus of systems and 'isms' with which the study of social problems is cluttered up, and the substitution of an empirical, concrete approach. The job of the social organization is to see that people are properly fed, clothed and housed, and that they have opportunity to form mutually satisfying relationships with one another. Generalities about socialism, communism, fascism, Marxism and what-not now contribute very little towards the solution of these problems. These generalities are, in fact, mostly quite meaningless.

The whole approach to social and political questions is still pre-scientific. Until we have renounced tribal magic in favour of the detached and relentless accuracy characteristic of science, the unconquered social environment will continue to make useless and dangerous our astonishing conquest of the material environment. The weakness of Dr. Parkes's book, and of its many predecessors, is not that it does not say things that are sensible and true, but that the debate is conducted on the wrong plane. The abracadabra of Marxism will only be finally disposed of as an incident in a much more comprehensive mental revolution.

Barbara Wootton.

THE EXTRA SPOTS OF THE LAUE PHOTOGRAPH

By Sir William Bragg, O.M., K.B.E., Pres.R.S.

SEVERAL workers have recently discussed the diffuse spots which often appear in Laue X-ray crystal photographs and do not belong to the Laue pattern proper. Thus Preston has given[1] illustrations of the spots in a number of cases and concludes that "the diffuse spots can be explained by the thermal vibrations of the lattice which break the crystal up into groups, consisting probably of an atom and its twelve neighbours. The thermal vibrations cause the interatomic distances to vary slightly from one group to another so that new diffraction maxima, characteristic of the group of atoms, are produced".

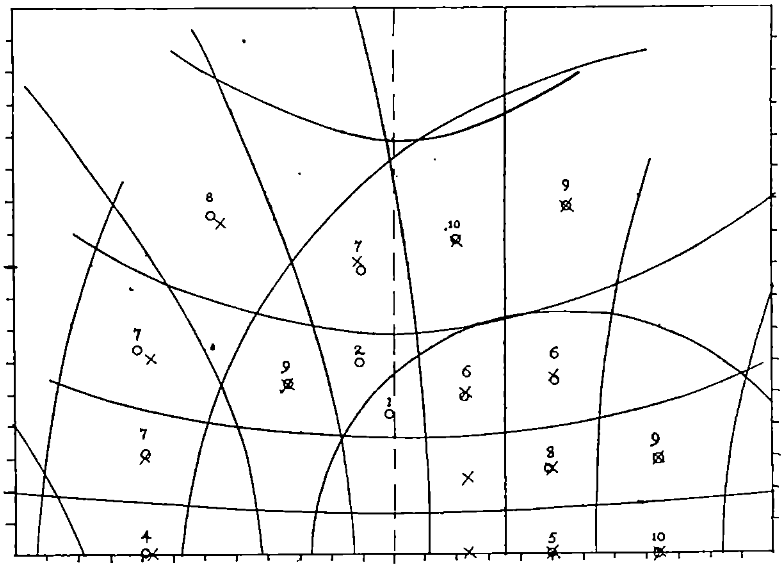


Fig. 1.

This diagram shows one half of the diffraction pattern referred to in the text. Observed diffuse spots transferred from the photograph are shown by crosses. Calculated positions are shown by small circles, and calculated intensities of maxima are indicated roughly by single figures. In the calculation of intensities no allowance is made for the effects of obliquity or of the dispersed arrangement of the scattering centres in the atoms.

If a pencil of monochromatic rays falls upon a group of scattering points in regular array in space, the diffracted rays take the form of a series of pencils which will produce a pattern on a photographic plate similar to the observed pattern of diffuse spots. The pattern so produced may be too weak to be observed; this will certainly be the case when the group is large enough. In the latter case, the crystalline arrangement of points must, as we know, be correctly oriented with respect to the incident ray. But when the group is small and there are sufficient groups which act more or less independently of one another and give a sufficient intensity in combination, there must be a diffraction pattern for all positions of the crystal containing the groups. The positions of the spots in the pattern are independent of the size of the group: and they change very slowly as the orientation of the crystal is changed.

Whether or no the spots of this diffraction pattern are actually the diffuse spots that are observed is a matter requiring proof. But at least it is worth observing how very accurately a calculation of the pattern predicts the positions of the spots and even to some extent their relative intensities.

It is, of course, true of a plane optical grating also that the positions of the diffraction maxima do not depend on the number of lines in the grating provided the spacing and wave-length remain unchanged. Nor do the directions of the diffracted pencils change much with the orientation of the grating. But there is no parallelism here to the characteristic crystal effect in which, when the number of atoms is large, observable reflection only occurs at definite orientations. This is a result of the three-dimensional arrangement. When the number in the group of atoms is small, the parallelism between the two cases is more complete.

A single illustration will illustrate the relation between calculation and observation. Suppose that a pencil of X-rays of wave-length λ, parallel to the z-axis, strikes a group of eight diffracting centres disposed at the corners of a cube of edge a. Let the cube be so arranged that one edge is parallel to the y-axis and two others are inclined at an angle θ to the axes of x and z respectively. In other words, the cube is tilted about the y-axis through an angle θ from a position symmetrical with respect to the axes. The tilt adds a complication to the problem which the hypothesis meets satisfactorily. The postulates of monochromatic rays and a simple cube can easily make way for more general cases later on.

The amplitude of the ray diffracted by the group of atoms in the direction *hkl* is then proportional to

$$\cos\frac{\pi a}{\lambda}\left\{h\cdot\cos\theta + (1-l)\sin\theta\right\}\cos\frac{\pi ak}{\lambda}\times$$
$$\cos\frac{\pi a}{\lambda}\left\{h\sin\theta-(1-l)\cos\theta\right\}.$$

It is somewhat laborious to calculate the positions of the various maxima of this expression, but the general lay-out of the diffraction pattern is easily found by putting each of the three factors of the formula in turn equal to zero. This gives three separate relations connecting h, k and l. The diffracted ray strikes the photographic plate, which is normal to the direction of the incident, at a point defined by co-ordinates x and y, where $x = hD/l$, $y = kD/l$, D being the distance from crystal to plate. Expressing the three h, k, l relations in terms of x and y, we have three families of lines on the plate at every point of which the intensity of the diffracted ray is zero.

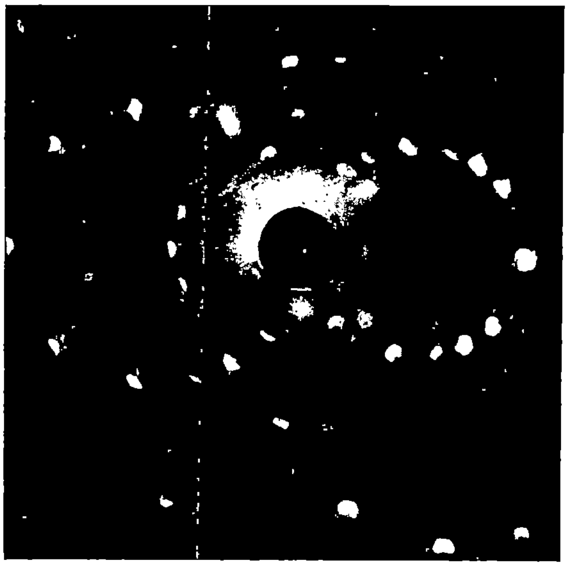


Fig. 2.
X-Ray photograph of potassium chloride; molybdenum α-rays; crystal tilted 20°.

The accompanying figure shows these lines in the case when $\lambda = 0{\cdot}71$ A., being the wave-length of the α-ray of molybdenum, and $a = 3{\cdot}14$, being the length of the edge of a cube of potassium chloride atoms, four potassium atoms and four chlorine atoms lying at alternate corners. As potassium and chlorine atoms are very nearly equal in weight, the group of eight atoms corresponds well to the hypothetical group of eight diffracting centres, except that they are not point sources. The angle of tilt θ is 20°.

The zero lines are ellipses and hyperbolas. As the angle of tilt is not large, two of the sets of curves are roughly parallel to the axes of x and y. The third, corresponding to the third factor of the formula, is a set of ellipses. A point of maximum intensity lies at the approximate centre of each area enclosed by zero lines; at the outskirts of the figure the point lies nearer the origin than the centre of gravity of the area, an effect due to the obliquity of the rays.

This figure is to be compared with the actual photograph. It is not possible to bring out all the details of the photograph, and this is especially true of the spots on the left of the figure, which are very diffuse and relatively weak. Some of the spots are hidden by Laue spots. I fear, therefore, that the positions of some of the spots must be taken on trust. Their calculated and observed positions are marked in the figure. The generally close agreement is obvious. The rays of the photograph came from a molybdenum target, and were not monochromatic. Thus every wavelength forms its own diffraction pattern, and according to the hypothesis under consideration there must be streaks radiating outwards, the spots being the more intense portions due to the characteristic rays.

The spots in the photograph are not so diffuse as the formula would lead us to expect. But the formula is based on the assumption of a group of eight atoms only; if more atoms are included in a group, the spots become sharper. If larger and larger groups are taken into consideration, the total effect becomes less and less until at last the diffraction effect now considered disappears, the crystal becomes perfect, and observable reflection is only possible when the Bragg law is fulfilled. As already stated, the positions of the principal maxima do not depend on the number of atoms in the group; but as the number increases the lines of minimum intensity multiply in number and change their positions while retaining their general form.

The formula is derived on the assumption that the eight diffracting centres are points. Actually, the chlorine and potassium atoms are extended in space, and in consequence the intensity of the diffracted ray falls away as the inclination of the ray to the original pencil increases. The spots must therefore be weaker at the edge of the photograph than at the centre. The spread due to obliquity has an additional effect of the same kind.

That such groups of atoms can exist and have independent action does not seem unlikely. Similar associations in a liquid must produce rings and not a pattern of spots, because in a liquid all orientations are possible. In a solid, the orientations of groups are more restricted. The smaller and the more numerous and the more independent are the groups, the more diffuse and also intense should be the spots. Perhaps in this way the effects of temperature can be explained.

The phenomenon of the diffuse spots has been discussed at length by a number of writers, but I venture to add this simple description of an effect which must exist whether it is observed or not. Faxen, in 1923, gave an explanation which relied on the existence of reflecting crystal planes in any zone, planes which could be correctly oriented for reflection even though one of the plane indices was incommensurable. He supposed that such extra planes could be produced by the passage of heat waves along the principal planes of the zone. In effect this gives the same result as a plane crossed grating, at least when there is no angle of tilt. That is because the unlimited choice of planes in a zone has removed the restriction of the three-dimensional arrangement. Zachariasen and Slater have examined the question more elaborately[2], and are conducting a series of experiments on the subject. So are Mrs. K. Lonsdale, Miss I. E. Knaggs and Mr. H. Smith, who have described their observations up to the present in NATURE[3]. To these last-named workers I am indebted for the photograph reproduced above. A discussion on lines which vary considerably from those taken by other workers has been given by Raman[4].

The positions of the extra spots in Raman's photograph of diamond can also be determined with accuracy by the method described above.

---

[1] *Proc. Roy. Soc.*, July 1939.
[2] *Phys. Rev.*, **57**, 597 and 795 (1940).
[3] NATURE, **146**, 332 (1940).
[4] *Current Science*, April 1940.

CHRISTIAN HUYGENS, 1629-1695

By A. E. Bell,

St. Marylebone Grammar School, London

THE central interest of Huygens' life and work may be said to be his relations with Galilei and Descartes on one hand, and with Newton and the English men of science on the other. Descartes and Galilei were the brightest stars in the scientific firmament at Huygens' birth, and they influenced him in one way or another all his life. When he died in 1695 his own star, though still bright, too quickly paled beside the brilliance of the ascendant Newton. A study of Huygens' collected works leads to the view that claims may well be made for wider recognition of the importance of his work.

Huygens' life came at a time just succeeding the long-prepared attack on Aristotle's science. His education was modern and included a study of the works of Archimedes, Galilei and Descartes, and the ardent Cartesianism of his famous father and his teachers profoundly affected his outlook. In fact Huygens was probably first stimulated in his scientific work by those writings of Descartes which Leibniz dismissed as "un beau roman de Physique". But without Huygens' researches Leibniz might well never have coined that phrase. Without Huygens, in fact, an important stream of scientific thought, instead of reverting to the methods of Galilei, might have followed Descartes to disaster. Nevertheless Huygens never completely forsook Cartesianism, no doubt owing to all the influences of his early years and partly perhaps because of his profound opposition to the law of universal gravitation and to the absolute space of Newton's "Principia". His scientific and philosophical position, indeed, cannot be indicated in a word, and a detailed consideration lies beyond the scope of this article.

Huygens is remembered for his discovery of Saturn's ring, his invention of the first practicable pendulum clock, his telescopic eyepiece and micrometer and his formulation of the wave theory of light. To these the historian would add his important researches on percussion and centrifugal force and his magnificent theoretical work concerning the pendulum clock (on the centre of oscillation of the compound pendulum and the proof of the tautochronism of the cycloidal pendulum). Then also there is his work on refraction at curved surfaces leading to general formulæ for lenses and lens combinations, the quantitative estimation of the effect of spherical aberration, the introduction of the concept of the optical centre of a thick lens and an important theorem containing the germ of the least action principle in optics. This leaves on one side his important work in pure mathematics, his lesser contributions to astronomy and his influence in the secure foundation of the Royal Academy of Sciences in Paris. Here we may concentrate on the main scientific conceptions he helped to establish in science in the course of these researches, and try to indicate why he became the "incomparable Huygens" to both Leibniz and

John Bernoulli, and "one of the chief Mathematick Luminaries of the present Age" to his English admirers.

The history of mechanics up to Huygens is really the history of statics. This is not surprising in a sense, for the first tendency, following the Neo-platonic revival of the sixteenth century which coincided with the decline of Aristotelianism, was to reduce most physical problems to geometry. Perhaps because of the absence of accurate time measurement, the time dimension scarcely entered into science. Even in Huygens' work, the geometrical method of presentation is dominant. In dynamics, however, the geometrical method was inadequate and Huygens had to invent his own procedure. He had, to start with, the law of constant acceleration of Galilei and its simpler deductions, the presumption of the law of inertia, the recognition of the vector nature of force (da Vinci and Stevin both obtained a proof of the parallelogram of forces) and certain ideas found in Stevin's work which may be said to have been the seed of a theory of virtual velocities. Galilei failed to relate force with motion and did not perceive the need of a distinction between mass and weight. The contributions of Descartes' brilliant but wrong-headed world-mechanism can only have served to confuse these questions.

Huygens' early studies were on the central problem of how motion is transmitted by impact. For this he introduced a famous device. He imagined a man standing in a boat which moves steadily with the stream. From his hands, spherical bodies of perfect elasticity are suspended by strings of equal length. In this way the bodies may be given any velocity in the direction of motion of the boat. With respect to a stationary observer on the bank and to the 'navigator' there are then two sets of co-ordinates on which to represent the motions of the bodies. Both representations are equally 'true'. Starting with certain self-evident axioms, Huygens was able, through this simple principle of relativity, to solve all the problems concerning impact between the masses whether equal or unequal. The correct formulation of the laws of conservation of momentum and of kinetic energy (*vis viva*) resulted from this work: mv and mv^2 (later modified to $\frac{1}{2}mv^2$) then entered physics with their modern significance. This involved a contradiction of all Descartes' work on the same subject and a revelation of his errors in the treatment of motion. Huygens treated mass as distinct from weight and implied an alternative method for comparing masses.

In his work on impact and still more on the centre of oscillation Huygens made great use of a fundamental principle (which he supposed to be self-evident) that the centre of gravity of a number of masses cannot ascend of itself through any motion of the masses under gravity. It followed that separate masses might have their centres of gravity brought to the height of the common centre of gravity "without the expenditure of any other force besides that which resides in the system"[1]. The principle also gave him a direct proof of Jordanus's theorem on the inclined plane. In his derivation of the formula for the distance of the centre of oscillation of a compound pendulum from the axis of rotation, Huygens combined this principle with Galilei's relation that the velocity acquired in descent under gravity varies as the square root of the height. The speeds of suspended particles at any point in the path were then deduced from the corresponding heights of descent, a procedure which really amounts, in combination with the conservation of *vis viva*, to the application of the law of conservation of energy in mechanics. Huygens had the formulæ but not the term. (Indeed if he had developed his ideas more fully the energy concept would have played an important part in physics much earlier than it did.) As for the rest of his work on suspended bodies of all forms, the derivation of the general formula is a masterly example of the inductive method and one which it is difficult to parallel. Parts of the problem could not be unravelled with the resources of classical geometry alone, and an astounding method of summation of elements had to be employed in obtaining the moments of inertia of certain solids of revolution.

Later in life, Huygens corresponded with Liebniz on the subject of the differential calculus and he collaborated with Fatio de Duillier on the new method. It came too late, however, to be of great help to him. His work illustrates almost tragically the need of the new weapon and the new notation. It is the same when we read his great work on the tautochrone, a curve which he discovered partly through practical experiments to correct the error of the clock pendulum and partly through an interest in the cycloid aroused by Pascal's 'Dettonville' problems.

Curiously enough, Huygens' study of centrifugal force also originated from his attempts to solve the practical problems of time measurement. The conical pendulum appeared to him at one time to offer certain advantages over the simple pendulum, and his first conical pendulum clock was probably constructed empirically. Huygens, of course, could not resist the temptation to investigate the laws of the new pendulum, and the theorems of the (posthumous) "De Vi Centrifuga" were the result. The statement of the theorems without proof was given at the end of the "Horologium Oscillatorium" of 1673. The importance of these for Newton's work is well known. After reading the book, Newton spoke of his "great satisfaction" with it, "finding it full of very subtile and usefull speculations very worthy of ye Author". It is interesting to note that Newton admired Huygens' classical mathematical style and considered him "the most elegant writer of modern times".

Huygens followed the traditional view, due first to Aristotle and found in Galilei, that rectilinear and circular motions were the fundamental forms of motion. Huygens was clear that uniform rectilinear motion had no effect on events which normally occur in an apparently stationary environment. This was the foundation of his 'relativity' principle mentioned above. Circular motion, however, was not of this kind but introduced new effects. It was only after the appearance of Newton's "Principia" that Huygens retracted this statement of the absolute nature of circular motion. He then (more consistently) took a firm stand on the relative nature of all motion and against the idea of any 'absolute' space. As for the conception of a gravitational force, innate and inherent in matter, this, he wrote, "appears to me absurd" and a conception which "takes us very far from the principles of Mathematics or Mechanics".

We have here Huygens' last dependence on the mind of Descartes. Whilst he rejected the latter's dictum that the essence of matter is extension—pointing out that hardness, for example, could not be deduced from extension—he remained a Cartesian in his belief in a pervading subtle matter. This subtle matter served as a medium for the propagation of light, and its rotation in vortices around each of the planets produced the effect of gravitation. Huygens considered he had experimental evidence both of the existence of the subtle matter and of the way in which its circular motion could produce a centripetal force. He found that mercury, in certain circumstances, would not descend from an inverted tube mounted in the manner of a barometer and placed in the receiver of an air pump. He failed to note the need of a film of moisture for this phenomenon, which is now ascribed to the tensile strength of the liquid, and instead supposed that a medium other than air supported the mercury column.. Huygens did not proceed from this subtle matter to embrace the entire vortex theory of Descartes. On the contrary, he saw that these vortices "are superfluous [in astronomy] if one admits the system of Mr. Newton where the movement of the planets is explained by the gravity towards the Sun and the *vis centrifuga* which balances it. . . ." Nevertheless, he himself rather illogically retained a limited vortex theory because he considered it essential to explain gravitation and because he needed the pervading medium in his wave theory of light. It may be mentioned that, for him as for Descartes, light was more than a mere phenomenon for laboratory study ; it was something cosmic, something belonging to the stars. One of Descartes' treatises was in fact called "Le Monde ou Traité de la Lumière". But when all is said, it is remarkable if Huygens did not perceive how completely Newton's "Principia" had shattered the Cartesian vortices.

There is little space in which to refer to Huygens' voluminous work in optics. In his laboured geometrical notation he introduced several important formulæ into optics, notably for refraction at convex and concave spherical surfaces, the position of the image formed by a thin lens and the magnification produced both by a single lens and by a telescope. He did much to improve the telescope by estimating the amount of spherical aberration of objectives and the optimum conditions for reducing this effect, and also by constant experiment on methods of grinding and polishing lenses. Through his labours astronomers gave up the quest for lenses of other than spherical form which had been started by Descartes. In his scornful way, Leibniz once remarked : "The best *apologia* that could be made for M. Descartes would be to complete his hyperbolic spectacles, which are the only useful things he discovered—if it were practicable to do so . . ." Huygens in fact showed that even this game was not worth the candle.

The main ideas of Huygens' "Traité de la Lumière" in which he expounded his wave theory of light are sufficiently well known. The most important points of superiority over other wave theories of the time were the idea of secondary wavelets generating a wave front, and the exact geometrical construction for the reflected and refracted rays. Huygens' attempt to explain double refraction by utilizing spheroidal wavelets as well as spherical ones and his relating of the spheroidal surface with the fine structure of the crystal are also brilliant exploits. The curious question of why back-waves are not observed was not overlooked by Huygens. But as the longitudinal vibrations were supposed to be transmitted through hard particles in contact and in accordance with his laws of percussion, Huygens considered a back-wave could only be set up if some particles smaller than the rest were present, for then only would there be a rebound of a particle after impact. When the particles are all equal the compressional pulse was transmitted without displacements occurring.

Huygens was inclined to be dogmatic and intolerant of ideas which were repugnant to him. Both over Fermat's least time principle—"this pitiable axiom"—and over Newton's work on the composition of white light, he had to alter his opinions. He was convinced that colour was a matter which was beyond mathematical treatment and his reception of Newton's early paper was very disappointing. Until the essential explanation of colour was reached, he wrote, "he [Newton] will not have taught us what the nature and difference of colours consists of, but only this accident (which assuredly is very considerable) of their different refrangibility". Huygens' attitude here recalls his criticism that Newton should have explained the cause of gravitation. These were the evil influences of the Cartesianism which he never wholly eradicated. For even whilst he perceived Descartes' faults more clearly than any of his critics, the outlook and the vision of the great philosopher had been too great a part of his early training to be utterly rejected. Huygens was in these respects a Cartesian in spite of himself. Mouy[2] has gone further than this and has contended that Huygens' work in effect instituted a mathematical Cartesianism, and that through Huygens Cartesianism did really enter modern science. Against this we have Huygens' own words, written late in life, that he could find "hardly anything" he could accept "in all the physics, metaphysics or meteors" of Descartes.

Huygens was in fact a modern. He showed scant respect for systems whether philosophical or religious, and accordingly had several clashes with the Jesuits and the doctrinaire Cartesians. Kircher, who adopted the cosmology of Tycho Brahe, he openly criticized for his timidity. We others, he asserted, are "without fear". It is thus not surprising that Huygens saw that Descartes, for all his brilliance, had really repeated the errors of scholasticism, for he had hoped to found a demonstrative and deductive science. More than any other man of science, certainly more than Leibniz, Huygens uncovered the errors of the great Cartesian mechanism. To him is due the fact that Cartesianism never became more than a provocative and stimulating vision of the realm of Nature.

[1] "Horologium Oscillatorium", Part 4, Hypothesis 1.

[2] Mouy, P., "Le Développement de la Physique Cartésienne 1646–1712" (1934).

OBITUARIES

Prof. C. G. Seligman, F.R.S.

BY the death of Prof. C. G. Seligman, emeritus professor of ethnology in the University of London, which took place at Oxford on September 19, anthropological studies in Great Britain have lost the support and inspiration of one who had been an outstanding personality as investigator in the field and as teacher for the greater part of the present century. As is shown by the record of his earlier years, he might well have attained eminence in more than one of the medical and kindred branches of scientific study; but his association with the late Dr. A. C. Haddon on the Cambridge Anthropological Expedition to the Torres Straits in 1897 inspired him with an interest in ethnology which ultimately led him to make the study of early man and the life of primitive peoples from every side and in the broadest sense the major object of his life work. Yet final judgment upon his standing in the world of science cannot fail to take into account that his acute and versatile mind was quick to seize upon the essentials of any new or suggestive lines of investigation in other branches of study, which might bear upon his own subject, such as, for example, recent developments in psychology and the interpretation of dreams, not only turning it to his own purpose, but more often than not also making some original constructive contribution of his own to its advancement.

Charles Gabriel Seligman was born in 1872 and educated at St. Paul's School, and St. Thomas's Hospital, London, where he became house-physician, studied pathology with a Salter research fellowship, and held the appointment of director of the Clinical Research Laboratory. In the meantime, as already mentioned, he visited Queensland, New Guinea and Borneo as a member of the Cambridge Expedition to the Torres Straits, studying native diseases, childbirth customs and other native practices, ceremonies and beliefs. On his return to England in 1899, while still holding his appointment in the Clinical Laboratory, he was preparing himself for further work in the anthropological field. This took shape in the Cooke-Daniels expedition to New Guinea in 1904, of which he was joint leader with Major Cooke-Daniels. Seligman's scientific observations on this expedition were embodied in "The Melanesians of British New Guinea" (1910), a work which set a new standard in detailed observation of a primitive people as well as in the analytical study of ethnological problems on a first-hand knowledge acquired in the field. On his return from this expedition, Seligman once more took up medical studies for a time. In 1906 he was awarded the gold medal in pathology at the London M.D. examination and delivered the Hunterian and the Arris and Gale Lectures.

Hence onward Seligman's interests centred in anthropology. To this his marriage to Brenda Z. Salaman contributed in no small degree. It in no way detracts from Seligman's qualities or achievements to say that his outstanding position as an anthropologist was in no small measure due to Mrs. Seligman's devotion, encouragement and collaboration. Their first joint enterprise was an expedition in 1908, under

Government auspices, to the Veddas of Ceylon, where much valuable work of observation was done. Their material was embodied in "The Veddas" (1911), a standard work of which they were jointly the authors. Mrs. Seligman's work on this expedition was complementary to that of her husband, for in their association Seligman was giving practical effect for the first time to a plea which Dr. Haddon had long urged for the inclusion of women observers for obvious reasons in ethnographical expeditions among primitive peoples.

This association was continued when from 1909 onward Seligman became interested in Africa, and was engaged for some years under Government auspices in the study of the peoples of the Sudan, not only collecting the information which was embodied in "The Pagan Tribes of the Nilotic Sudan" (1932), but also laying the foundations of what is now the most efficient native survey service under British administration. Of the scientific importance of Seligman's discoveries among the Nilotic tribes in relation to the history of the kingship all readers of later editions of Frazer's "Golden Bough", as well as of his own Frazer Lecture, "Egypt and Negro Africa, a study in the Divine Kingship" (1934), are well aware. Another outcome of Seligman's African studies was an excellent little volume "The Races of Africa" in the "Home University Library".

Seligman was possessed of a highly developed artistic sense, which his scientific interests had fostered rather than blunted. It led him to the study of Chinese art and antiquities. He formed a small but choice collection, for which he built a museum at his home at Toot Baldon, and made his last journey of any considerable extent when in his later years he visited China to obtain a first-hand view of Chinese culture.

In 1910 Seligman was appointed lecturer in ethnology in the University of London and in 1918 he became professor in that subject, being attached to the London School of Economics, where he was associated with Prof. B. Malinowski. He retired in 1933, being granted the title of professor emeritus. The value of his work was widely recognized. In 1915, he was president of Section H (Anthropology) of the British Association; in 1918 he was admitted to fellowship of the Royal Society; and he was president of the Royal Anthropological Institute during 1923–25. He was awarded both the Rivers Memorial Medal for work in the field (1925) and the Huxley Memorial Medal (1932) of the Royal Anthropological Institute, as well as the Annandale Memorial Medal of the Royal Asiatic Society of Bengal (1931).

The late C. G. Seligman and I were very old friends. We were born in the same year and met first at about the age of sixteen at the house of the late F. M. Halford, the greatest authority of his day on dry-fly fishing. We were both beginning to be interested in biology, and Halford was an enthusiast in microscopy, possessing a powerful binocular instrument with the then new oil-immersion lenses. We used to visit him on most Sunday afternoons; another of his young visitors being the late Edwin Montagu, afterwards Secretary of State for India and a successful promoter of sanctuaries for rare birds.

Seligman proceeded from school to St. Thomas's Hospital, I to Cambridge. But we spent two summer holidays during these undergraduate years together, one on a walking tour in the New Forest, the other on a visit to Norway. Even in these early days his outstanding characteristics were his absorbing love for biological research, his power of concentration and his independence. His possession of independence was scarcely surprising, as he had lost both parents at an early age and was brought up in the homes of strangers.

Thus it was that in 1897, when the late A. C. Haddon was considering the personnel of his memorable expedition from Cambridge to the islands of the Torres Straits, New Guinea and Borneo, I (his old pupil) brought the two together, and Seligman accepted his offer to join it. Under the guidance of Haddon and Rivers, Seligman learnt his anthropology. At first he made a speciality of investigating native diseases and native treatment, collecting medicinal and other plants and information about the customs and rites of women during parturition and at puberty. But later his work during the expedition covered almost the whole field of anthropology.

While Rivers, McDougall and I were carrying out mainly psychological investigations in Murray Island. Seligman was for most of the time in New Guinea. While there, so keen became his interest in ethnology that he seriously considered the offer which he received of medical practice at Port Moresby.

The expedition decided Seligman's career in ethnology as it did mine in psychology. I have already mentioned his whole-hearted devotion to science, his perseverance and his thoroughness. His bravery in the face of continuous ill-health during later life is also noteworthy. To these qualities he added the wider social ones of blunt honesty and of unfailing loyalty to his friends. C. S. Myers.

In a message received from Sir James Frazer, he asks us to say he esteemed very highly Dr. Seligman's contribution to the science of man; he regrets that the state of his eyesight prevents him from making a fuller acknowledgment of the debt which he owed.

Prof. L. O. M. von Rohr

The announcement of the death of Prof. Louis Otto Moritz von Rohr will be greatly regretted by his many scientific friends in Great Britain.

Prof. von Rohr was born at Lazyn, Kreis Hohensalza, Germany, on April 4, 1868, and had therefore reached the age of seventy-two.

At the University of Halle he was a student under the late Prof. G. Contor and obtained there the degree of Ph.D. in 1892. A few years thereafter at the age of twenty-seven he commenced his life-long association with the firm of Carl Zeiss as technical collaborator under the arrangement introduced by the late Prof.

Abbe whereby young men of ability, while holding academic appointments, were engaged by Messrs. Zeiss, to the advantage of the collaborator and of the firm. They were afforded the opportunity, so often lacking elsewhere, of communicating direct to the firm the results of special research and of participating in the work of development, and in so doing of acquiring technical experience of the most advanced nature. Dr. Moritz von Rohr undoubtedly appreciated the importance of such a connexion and made the fullest use of his opportunities.

In 1913 von Rohr received the additional appointment of assistant professor in the Department of Medical Optics at the University of Jena. His interests were soon diverted to the field of optics and particularly ophthalmics; but although he might have made a name for himself in the more creative field of research, he became at an early stage of his career greatly interested in the history of the science to which he had become devoted. Even in his earliest contributions the historical aspects of the subject tend to predominate over the more technical details.

Von Rohr soon became by far the most important writer in every branch of historical optics. Although his knowledge of previous writings was profound, much of his material was the result of personal research. To ensure the accuracy of the information, he travelled widely and was unsparing of his strength. Few writers on any one subject can ever have been the author of so many contributions. The list is of extraordinary length. Dr. von Rohr will be remembered not so much because of any outstanding original creative work, but rather as a historian who discovered and recorded much valuable material that otherwise would have been lost to the scientific world. James Weir French.

Prof. Hans Zinsser

The recent death in New York of Prof. Hans Zinsser, when he had nearly completed his sixty-second year, has removed an outstanding personality from the ranks of American bacteriologists. His work in the field of immunology and his researches during the past ten years into the prevention of typhus fever by means of a vaccine prepared from the causal organism had secured for him a world-wide reputation. Moreover, numerous interests, which extended far beyond the sphere of his scientific work, engaged his leisure hours, and thus he gave the impression of having lived intensely, even during the prolonged illness of which he clearly foresaw the inexorable end.

Zinsser was professor of bacteriology at Stanford University, California, from 1911 until 1913; at Columbia University, New York, from 1913 until 1923; and afterwards at Harvard Medical School, Boston. He was a member of the American Red Cross Sanitary Commission to Serbia in 1915; and in 1917 he served in the Medical Corps of the U.S. Army in France, where he acted as assistant director of the laboratories. In the summer of 1923 he visited Russia as sanitary commissioner for the Health Section of the League of Nations.

Problems investigated by Zinsser and his co-workers include: the mechanism of bacterial allergy; the immunological significance of certain non-protein substances extracted from the tubercle bacillus and other bacterial species, a series of observations which were later illuminated by Avery and Heidelberger as a result of their pioneer work on the type-specific polysaccharides of the pneumococci; the essential identity of the various manifestations of the antibody reaction; a comparison of the precipitation and agglutination reactions as influenced by the surface, in the aggregate, of the antigenic particles exposed to the action of the antibody component; and—in a different category—studies on the causative virus of Brill's disease, of herpes and of typhus fever.

Zinsser was the author of a lucid, exceptionally well-written and deservedly popular text-book of immunology under the title "Resistance to Infectious Diseases"; he prepared the latest edition with the aid of his colleagues Enders and Fothergill. His book "Rats, Lice and History", a popular account of the history and mode of transmission of typhus fever, won the good opinion of readers on both sides of the Atlantic not only by its solid background of knowledge but also by the numerous divagations from the main theme into the by-ways of literature and philosophy with which the reader is beguiled. He has also written an objective account of his life and experiences, which was recently published in the United States and has been acclaimed to be of unusual merit. We understand that the book will appear shortly in Great Britain, and we cannot doubt but that the self-portrait it contains will reveal the character of one whose interests ranged widely throughout the domains of thought and action and who, when his health finally broke down, met his fate with calm and even light-hearted courage. Perhaps, after all, it was for the best that a man of his intellectual energy should have been spared the "cruel disintegration of slow years", the tragedy of old age to which he thus alludes in the last sonnet he wrote. G. F. Petrie.

We regret to announce the following deaths:

Dr. William Bowie, president during 1933–36 of the International Union of Geodesy and Geophysics, on August 28, aged sixty-eight.

Prof. R. S. Dugan, professor of astronomy in Princeton University, on August 31, aged sixty-two.

Sir Henry Head, F.R.S., the eminent neurologist, former editor of *Brain*, on October 8, aged seventy-nine.

Prof. E. H. Lindley, professor of psychology in the University of Kansas during 1898–1917, on August 21, aged seventy-one.

Prof. H. H. Nicholson, professor of chemistry in the University of Nebraska during 1882–1905, on August 17, aged ninety-five.

Prof. Vito Volterra, For. Mem. R. S., formerly president of the International Committee of Weights and Measures, aged eighty.

NEWS AND VIEWS

The War and the British Fauna

It is probably still too early to judge the effects of the War upon British wild life, for it was not until the second or third years of the War of 1914–18, when the calling-up of older men had more extensively depleted the gamekeeping profession, that the great increase in so-called 'vermin', including rarer species like the wild cat and polecat, became of national concern ; nevertheless, the present War has speeded up a great deal of this disturbance of wild life by the greater activity at home. The most noticeable effects have been an extension of the range of normally persecuted species like the carrion-crow, fox, otter, kestrel, little owl and sparrowhawk, and this may be followed by a slower extension of species like the badger and raven. The use of sand-dunes and lonely islands in the coastal defences and of rural parks for training the army has considerably disturbed the nesting haunts or 'sanctuaries' of uncommon species, particularly birds, more so than the building of factories in rural areas, and this may have a permanent effect in further reducing the nesting population of terns, waterfowl and waders.

On the other hand, the breaking up of estates and game preservation is furthering the extension of the little owl and the grey squirrel in the north of England. As in 1914–18, the rumour has gained popularity that warfare on the Continent has sent rarer Continental birds to nest in England, notably the avocet in Essex, but it is unlikely that the campaign abroad had any effect upon the British avi-fauna. Pollution of rivers has again arisen, notably on the Severn, Bristol Avon, and the Derbyshire Derwent, with considerable loss of fish life. It yet remains to be seen if the rosebay willow-herb will emulate the story of the London rocket in spreading over ruined buildings in London and other cities ; that the poppy will recolonize the Flanders area in its former abundance is very likely, for the destruction of buildings has again made the soil highly calcareous.

Civic Development under War Conditions

A leading article in *Engineering* of September 27 shows that if no effective means be found to ensure the abolition of warfare the motives which have influenced the location of communities in certain districts of the earth's surface will be much the same in the future as in past history. Food and water, a dwelling-place of some kind and a reasonable measure of security against weather and the assault of enemies, these things are desired by the human race and by beasts and birds and even insects. Applied science has facilitated the establishment of communities in places where otherwise life could be maintained—if at all—with the greatest difficulty. On September 13 was celebrated the fiftieth anniversary of the foundation of Southern Rhodesia by the pioneer column which had trekked from Kimberley to take over and develop the territory for which mining concessions had been granted to Cecil Rhodes by Lobengula, the Matabele chieftain. On September 29, as related by Mr. W. J. Jarvis, city engineer of Salisbury, in a paper published in this number of *Engineering*, a beginning was made in the construction of the waterworks. The intervening fortnight had been occupied with the building of a fort which the pioneers had completed on the previous day. It is significant of the unchanging essentials of colonization that the assurance of a proper water supply was regarded as a necessary preliminary to all other activities, even though the fort was erected in close proximity to a river. It was only on the following day, September 30, 1890, that mining law was provisionally proclaimed, and prospective licences were issued to enable the provisional members of the column to proceed about the business which had brought them into what is now Southern Rhodesia.

This is a good example of the processes which have led to the establishment in their present situations of so many capital cities, the origins of which go far back into the history of mankind. It was not chance that located London and Paris and Rome and the many industrial cities like Newcastle and Sheffield in their present situations. In many cases the main considerations were the military ones which governed communal life until the general spread of a more ordered existence. Prior to 1914 this state had remained for so long in Great Britain that people had begun to regard it as settled and immutable, in spite of the wars that had periodically afflicted other European nations. The four years of war from 1914 to 1918, while they may have shaken this belief to some extent at the time, did not eradicate it. In fact the conviction that a war of such a prolonged and costly character could not be quickly followed by another seems to have encouraged both civil and industrial expansion in directions which it could scarcely have taken if the lessons of history had been properly assimilated. The experiences that Europe in general has undergone in the last twelve months suggest that the military considerations which have gradually lapsed into the background should once again be given due weight in planning for future mass movements of populations.

Heating Private Air Raid Shelters

The efficient heating and lighting of air raid shelters is a problem of interest to many at the present time. A solution suggested by Mr. D. Bellamy, the general manager of the Hull Electricity Undertaking, has much to recommend it. He has prepared a scheme extending the existing assisted wiring scheme so as to include lighting and power plug points in domestic shelters free to the consumer. The offer is to install one lighting and one five-ampere plug socket for a charge of 1*s*. per week for 18 months ;

alternatively the provision of a 'warden' fire in addition to one lighting point and one 5-amp. plug socket for 1*s.* 3*d.* per week for 18 months. These proposals have been unanimously approved by the Electricity Committee, and will be put into operation as soon as the necessary approval has been obtained to the financing of the scheme. After the scheme has been approved by the Electricity Commissioners it is hoped that it will be put into operation. It is to be hoped that similar facilities will be made widespread by other undertakings throughout the country. Winter is immediately ahead, with much illness to come if the shelter-comfort problem is not dealt with promptly.

Air Raid Precautions for Users of Ammonia

The Ministry of Home Security has recently issued a pamphlet on "Air-Raid Precautions to be taken by Users of Ammonia" (London: H.M. Stationery Office. 1*d.*). The extensive use which is now being made of anhydrous ammonia refrigerating plants makes the question an urgent one. The main precaution recommended is to keep stocks of anhydrous ammonia down to the absolute minimum. If the capacity of a given plant is sufficient to provide a reservoir, no reserve stocks at all should be kept. Where it is essential to keep additional supplies in cylinders, these should preferably be dispersed to protected positions in the open away from risk of fire and stored horizontally. If such a dispersal is impracticable, the cylinders should be placed in an angle of the walls of the building and suitably protected on the exposed sides. Precautions against the escape of ammonia from the refrigerating plant include the provision of sills around the area over which liquid ammonia may flow from a broken condenser coil; and it is suggested that the condenser water should be kept running, as ammonia is readily soluble in water and the aqueous solution is less dangerous than the anhydrous liquid. In an emergency, the charge in the machine should be isolated by closing all possible stop valves. To facilitate this operation by possibly inexperienced personnel, the engine-room master-valves may be painted in striking colours. It is pointed out that cylinders to be emptied should be laid horizontally, so as to discharge the ammonia in liquid form, due care being taken to avoid burns by the splashing of the liquid.

Electric Power Stations Underground

As we see things at present, unless war can be banished from the earth we may have to revise our ideas completely as to underground power plant and underground shelters. The only really safe refuge in a great city assaulted from the air is a chamber far below the surface such as we find along some of the lowest tunnelling of the electric tubes, a level well below the maximum depth excavated by the comparatively feeble bomb of 1940. In the *Electrical Times* of September 26 it is stated that soon after the War of 1914–18 a few eminent consultants and power plant engineers sent the editor outline ideas of generating stations placed underground at low level. One of the difficulties which appeared insurmountable at that time was the supply of cooling water in large bulk at these depths. The inlet of water is easy enough, but what of the outlet? The case is a little less puzzling in that of oil-driven prime movers, but even these would strain the engineer's resources and ingenuity.

When the struggle at present raging reaches a settlement, inquiry may well be reopened. Excavations to a considerable depth and on a large scale may become essential, if only for providing an absolutely safe refuge for distracted people and hospital patients and staffs. Underground stations, too, are being used as air raid shelters. This is one stage of a difficulty which in time might become formidable; it will have to be considered along with the other problem of finding a safe lodging for the much-discussed electric power house.

British Rheologists' Club

Since the outbreak of War, new and urgent problems concerning the flow and deformation properties of materials (rheology) have arisen in many industries and in research, and a group of British rheologists have therefore formed a club for mutual help and discussion. Prof. G. I. Taylor, Yarrow research professor of the Royal Society, has accepted the presidency. The objects of the new Club are "to co-ordinate the activities of Rheologists in Britain during the War, to further the appreciation of the importance of rheology in industry and to facilitate the pooling of information (where it is desirable) with respect to problems and new methods of research". Membership of the Club is open to any individual working or interested in rheology who is resident anywhere in the British Empire, and there is a nominal subscription of five shillings per annum. Arrangements are in preparation for an inaugural meeting of the Club to be held at the National Institute for Research in Dairying, University of Reading, on November 16, when it is proposed to hold an informal discussion on a topic to be selected, followed by an inspection of rheological apparatus including some recent developments. Fuller details of the Club may be obtained from the honorary secretary, Dr. G. W. Scott Blair, c/o Institute of Physics, at the University, Reading, Berks.

Primitive Art: Past and Future

The anthropologist, when confronted with some of the more extreme pronouncements of æsthetic judgment on the primitive artist, was at one time perhaps a little too apt to regard them as unwarranted apotheoses of what was after all a phase and no more in a process of æsthetic development or 'evolution', differing in this relation in no essential from any other cultural element depending upon technical achievement. He was, however, so far justified in that each example of the artist's skill and taste was to be regarded with reference to its social and religious background; and while it might, and very often did, afford satisfaction to a judgment habituated to European canons, to award it the highest mark as an expression of æsthetic principles, as, for example, in the better-known specimens of West African sculpture, seemed to attach a false value to characters which were, in historical perspective, faults of technique rather than an outcome, conscious or unconscious, of any theory of artistic balance, selection or composition. A saner method of approach to the products of primitive art was illustrated by Dr. Leonard Adam in a recent lecture delivered before the Royal Society of Arts (*J. Roy. Soc. Arts*, June 28, 1940) in which he briefly directed attention to certain of the main principles of primitive art which emerge from its study in accordance with the evolutionary or cultural methods elaborated by the late Dr. A. C. Haddon, Prof. Franz Boas and others. Incidentally Dr. Adam stressed the interest and importance of the art of the American Indians of the north-west coast of America, which has suffered neglect in favour of the culturally less illuminating art of Africa.

The future of primitive art is, when properly understood, no less interesting than its past. It is true that in many parts of the world European impact has brought about degeneration; but experience in West Africa has shown that this is not inevitable. It was pointed out by Dr. Adam that modern ethnographical studies have demonstrated that early observers tended to overstress the static element in primitive culture. Art, however, like other cultural factors, has been subjected to a continuous process of change. Much of the so-called primitive art is in fact both highly sophisticated and 'evolved'. The result of such European guidance in West African education as has been formulated with understanding of native modes of thought has been to produce a native school of art, which not only in the traditional art of wood-carving, but also in other branches of artistic activity such as painting, is thoroughly African in conception, feeling, and atmosphere. It has survived or overcome the break with the social and religious factors upon which African art depended, but which vanished, or are vanishing, before European contacts. Hence, as Dr. Hanns Vischer pointed out from the chair on this occasion, this development indicates a line of advance in the present deplorable state of education in Africa—a beginning "to make grow . . . to liberate something which has been stifled under the thick crust of foreign knowledge acquired without real understanding".

Rufford Village Museum

Rufford Village Museum, which was opened at Rufford Old Hall, a National Trust property in West Lancashire in July of last year as: "A Museum of Folk Culture and Industry: To illustrate and capture the spirit of the countryside" (to quote its constitution) is being developed by the honorary curator, Mr. Philip Ashcroft, jun., to be "an example for other districts to follow, so that in the future, each village or group of villages will have a museum to represent their life, history and culture". In addition to Baron Hesketh's extensive collection of old armoury and other relics of medieval life, Mr. Eric Hardy has drawn up lists of the local fauna and flora which will be exhibited above photographs, drawings, diagrams, etc., of wild life to encourage people to preserve as well as observe the wild life of the parish. This happens to be unusually rich, for the flora includes flowering rush, flowering fern, arrowhead, yellow waterlily, water soldier, bladderwort and nearly a thousand other plants; there is a list of twenty-two mammals for the parish and F. A. H. Hall and E. Hardy have drawn up a list of 101 bird records, including sixty nesting species—a third of the British records. The Museum itself is a historic old timbered hall, the restored part of which dates from the seventeenth century.

Research in Social Relations in Industry

Mr. H. Valder, of Hamilton, New Zealand, has endowed for five years a research fellowship in social relations in industry at Victoria University College, Wellington, N.Z. Mr. Valder has himself done original work in investigating problems of industry, more especially those concerning the relation of capital and labour, and he believes that the work can be carried further by a man with scientific knowledge. To ensure that the investigator may be independent, the work is to be done under the ægis of the Victoria University College Council, and the appointment will carry with it the privileges of a professorial chair in the College. The salary offered is £1,000 a year (N.Z. currency) for five years. Applications from candidates should be sent to the Registrar of the College.

Forestry Investigations in India

The activities of the Forest Research Institute at Dehra Dun, India, are summarized in a report entitled "Forest Research in India and Burma, Part 1, 1938–39". The work of the various branches of the Institute is described and the report forms a record of a large amount of useful work carried out in the interests of the State. Apart from research work, an enormous number of queries relating to the utilization of various forest products has kept the staff extremely busy during the year. It is noteworthy that all the provinces of India now employ an officer solely dealing with sylvicultural problems. The co-ordination of this work and advising on statistical requirements, in order to make the best use of the researches going on, have taxed the Sylvicultural Branch of the Institute severely.

It is not possible to make more than passing reference to a few of the programmes of work that are being carried out. The destruction of timbers by termites and by fungi is one of great importance, and this work is closely linked with problems of the seasoning and preservation of woods of many kinds. The paper-pulp section is another activity of great importance and promise, and questions connected with the manufacture of paper and plywood were probably the most numerous of all. The report itself, it may be added, is printed on paper made at the Institute from *Saccharum arundinaceum*. The cultivation of drugs is another aspect of work that presents many problems of interest. The exploration of the potentialities of Derris as an insecticide is very encouraging, while proof that the alkaloid ephedrine, present in Indian species of Ephedra, is in no way inferior to the Chinese product as a potent remedy for asthma, opens up possibilities for India in this connexion. It is hoped that failure in the past to attend to certain essentials regarding the collection of the plants will be remedied and full advantage taken of the present opportunity for developing trade in Indian Ephedra. Among other subjects spike disease of sandalwood is still under investigation, but proof is needed that Jassidæ (leaf-hoppers) are the vectors concerned with the transmission of this baffling kind of disease.

Scottish Society for Research in Plant Breeding

THE report for 1940 of the director of the Plant Breeding Station at Craig's House, Edinburgh, includes several important practical results of scientific research. It is shown that the renovation of semi-derelict pastures is best performed by ploughing up and re-sowing. A nurse crop of Sandy oats to be grazed in July, and a mixture of varieties of one grass species, together with wild white clover, are found to be preferable to sowing a mixture of grass species under rape or a seeding nurse crop of oats.

The Ainville sub-station, used for trials, has been transferred to six acres of land, six hundred feet above sea-level, at Boghall. The breeding of potatoes resistant to blight and to virus disease is meeting with considerable success, and several selections are being further tested. It is now possible to investigate the genetical background of resistance to pure strains of the *B*, *C* and *X* viruses. The available evidence indicates an autotetraploid segregation with dominance for susceptibility. Resistance to finger and toe disease in swedes is being tested both among new seedlings and in the field. Beans, wheat, barley and kale are among the other crops which are being bred for practical purposes under the guidance of scientific principles.

Institute of Organic Chemistry in Moscow

IT is announced by "Russia Today" Press Service that work has been commenced in Moscow on the new building for the Institute of Organic Chemistry of the Academy of Sciences of the U.S.S.R. The building will consist of three blocks, the main one of which (the laboratory block) will house the seven departments engaged in the study of the different branches of organic chemistry. This block will have a volume of 1,907,000 cubic feet. In addition, there will be an autoclave building and a block for big installations and workshops, with an aggregate volume of 388,500 cubic feet. Spacious accommodation has been set aside for a library of 70,000 volumes, as well as a big reading-room and an auditorium for 250 persons. The cost of the new building, not counting special equipment, is estimated to be 12½ million roubles. It is hoped to complete it in 1942.

Military Training for University Students

SINCE it is recognized that young men of eighteen and onwards at universities cannot undertake home defence duties without undue interference with their studies, it has been decided to expand the contingents of Training Corps at universities so that every student may enrol to obtain basic military training. Those who wish to serve in the Royal Air Force will have an opportunity of joining a university air squadron. By these means university education will be maintained, and undergraduates will be enabled to acquire useful experience.

Postponement of Nobel Awards

ON October 11 the Board of the Nobel Foundation asked the Swedish Government to allow a postponement in conferring the Nobel Prizes of 1940 for literature, physics, and chemistry until the 1941 prizes are conferred. The Medicine Prize was yesterday reserved until 1941 by the Faculty of the Carolean Medico-Surgical Institute in Stockholm.

Announcements

THE seventeenth award of the Duddell Medal of the Physical Society to Prof. E. O. Lawrence, of the University of California, which was announced in NATURE of June 1, p. 852, has a significance deeper than the honouring of a great American physicist's achievements in the invention and development of the cyclotron. Circumstances permitting, Lord Lothian, the British Ambassador to Washington, will present the Medal to Prof. Lawrence at Philadelphia on the evening of December 27, 1940, the occasion being that of a dinner in connexion with a three-day meeting of the American Physical Society. It is a particularly appropriate occasion, for on the same day there is to be also a meeting of the American Association for the Advancement of Science, at which Prof. Lawrence, as a retiring vice-president, will address one of the sections.

THE following appointments in the Colonial Service have recently been made: P. Adames, agricultural officer, Sierra Leone; E. S. Capstick, agricultural officer, Sierra Leone; J. H. Hinds, Agricultural officer, Gold Coast; J. A. N. Burra, assistant conservator of forests, Gold Coast; J. P. W. Logie, assistant conservator of forests, Kenya.

MORE than 100,000 books were destroyed or severely damaged in a fire following the bombing of the University College library during a recent air raid on London. Two members of the staff were killed and eight were wounded, and the memorial hall was almost demolished.

Chronica Botanica, the international plant science journal, established in Holland in 1935, is being published fortnightly in the United States (annual subscription, about the same as formerly when the journal was published as a bi-monthly, 7.50 dollars, foreign and domestic, post paid). Communications should be sent to Dr. F. Verdoorn, P.O. Box 151, Waltham, Massachusetts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Non-Lethality of the Mid Factor in *Lythrum Salicaria*

In 1927 East[1] proposed a theory of the inheritance of style-length in tristylic *Lythrum Salicaria* which involved three factors. One of these, *S*, was epistatic to the others, and determined Short style as opposed to Mid and Long. The other two, each of which was supposed to give Mid style as opposed to Long, were lethal when homozygous and were linked. In 1932 East[2] seemed to abandon this theory in favour of a single non-lethal factor, having found for the first time a plant which, crossed with Long style, gave a large progeny nearly all Mid. In 1936, however, he explained[3] that the 1927 theory was not abandoned, but applicable in his opinion only to the special type of plant with which first Barlow and later he himself had worked.

As Barlow[4] was the pioneer in the genetics of Lythrum, it would be very strange if she had encountered a strain of plants in which the mechanism of the inheritance of style length not only presented unusual features, but also had been totally transformed by the substitution of two linked lethals for a single non-lethal factor in the determination of the Mid style-length, especially as all three factors have *ex hypothesi* no recognizable effects except on the form of flower. At the time of East's second paper[2], therefore, one of us planned a series of tests, involving no illegitimate matings, and using an open pollination technique. It was hoped in this way to avoid disturbances to the phenotype ratios, due possibly to illegitimate pollination, and it was soon found that large progenies with entirely reliable ratios could be obtained in this way.

The first step, aimed at settling the question of lethality, has now been completed. Four Short plants from seed of an open pollinated plot, grown at the Chelsea Physic Garden in 1936, were tested by open crossing with Long at Harpenden in the following year, and sufficiently large progenies were grown at Merton in 1938. The following classification was obtained:

Family	Long	Mid	Short	Total
A	123	0	135	258
B	130	0	130	260
C	141	0	127	268
D	63	64	139	266

The absence of Mid progeny out of 786 in the first three families is good evidence that stray pollen was effectively absent. The Short parent of family *D* evidently contained a single gene for Mid style-length. Two other such Short plants have since been found among eight more from open-pollinated seed tested in 1940.

The Short parent *D* was grown with a Mid daughter from the family set out above, in isolation in Dr. F. Yates's garden at Harpenden, and two progenies from the reciprocally crossed seed were grown this year at Merton. Since both parents contain the same gene for Mid style-length, the test is critical for the lethality of this gene. If it were lethal we should expect 2 Mid : 1 Long, otherwise 3 Mid : 1 Long.

The two progenies obtained have now been scored as follows:

	Long	Mid	Short	Total
Mid X Short ..	28	103	117	248
Short X Mid ..	25	78	94	197
Total ..	53	181	211	445
Expected (non-lethal)	55·62	166·88	222·50	

The parallelism and homogeneity of the reciprocal progenies afford further confirmation of the absence of stray pollen. As regards the segregation for Mid and Long, the frequencies accord well with the expectations for 3 : 1 (χ^2 less than 0·7, from one degree of freedom); but are incompatible with a 2 : 1 ratio (χ^2 greater than 12·0). It is virtually certain, therefore, that the gene tested is not lethal.

The material from these progenies will be available for testing other possibilities not considered by East. Of these perhaps the most important is that of autopolyploid inheritance of the chromosome carrying the Mid gene. If adequate numbers can be tested, we may anticipate finding, both among the Mids and the Shorts, plants which have certainly received the same gene from both parents, and may in this case parallel the behaviour of those which East regarded as containing linked duplicate lethals.

R. A. Fisher.
Galton Laboratory,
Rothamsted.

K. Mather.
John Innes Horticultural Institution,
Merton.

[1] East, E. M., *Genetics*, 12, 393–414 (1927).
[2] East, E. M., *Genetics*, 17, 327–334 (1932).
[3] East, E. M., *Amer. Nat.*, 70, 5–12 (1936).
[4] Barlow, N., *J. Genet.*, 3, 53–65 (1913); 13, 133–146 (1923).

Cardiac Metabolism and Rigor in Thyroidectomized Rats

In order to elucidate the possible influence of the thyroid on heart metabolism, the effect of thyroidectomy on the course of cardiac rigor in rats has been studied.

Rigor was followed graphically according to the method of Chang, Patras and Templeton[1]. The results obtained are summarized below and will be published in full detail elsewhere. For the present purpose, two time units of measurement will be distinguished: (*B*) the time in minutes from the removal of the heart to the onset of rigor, and (*S*) the time in minutes from the removal of the heart until rigor is maximal.

Rats which are rendered unconscious by a blow on the head or neck yield a shock rigor curve which is far shorter than normal. It may be seen from Table 1 that treatments 3, 4, 6, 8, 9 and 10 enhance the shock effect and lead to an onset of rigor immediately after the heart beat ceases. The onset of the effect and its disappearance on recovery are reflected in the shape of the rigor curve. Digitalis or cardiazol (Table 1, treatments 5 and 7) almost completely nullify the influence of brain shock, asphyxia, or exhaustion on the rigor, but do not nullify the influence of thyreotoxic principle. Chronic asphyxia (45–120 min. exposure to an atmosphere of approximately 5·8 per cent oxygen) does not influence the rigor curve.

TABLE 1

No.	Normal		Thyroidectomized		Treatment
	B	*S*	*B*	*S*	
1	25·0	44·2	44·4	67·8	Amytal narcosis
2	10·0	22·1	42·6	59·9	Shock by blow on neck
3	4·2	14·2	47·0	62·3	0·5 mgm. strychnine + blow on neck
4	6·0	17·3	39·5	61·5	0·008–0·02 gm. caffein sodium benzoate + blow on neck
5	26·0	40·3			5–6 mgm. cardiazol + blow on neck
6	9·0	23·0	37·9	55·2	20 minutes swimming, death under amytal narcosis
7	15·4	36·4			Same treatment + previous digitalis treatment
8	5·0	13·3	17·4	35·7	KCN (6 mgm. subcutan.), death under amytal narcosis
9	1·5	5·0	2·0	8·5	0·15 mgm. mono-iodoacetate, death under amytal narcosis
10	3·8	9·0			Iodothyrine + blow on neck

The cardiac rigor curve of thyroidectomized rats is essentially different from that of normal rats (Table 1). The former is of markedly greater duration and is not influenced by brain shock, caffeine or strychnine administration. Exhaustion does not affect this curve. Digitalis is without influence upon it. Acute asphyxia causes a marked but relatively smaller curtailment of the rigor curve when thyroidectomized rats are used. Chemical rigor produced by mono-iodoacetate poisoning is, on the other hand, essentially the same in thyroidectomized as in normal rats.

The beating time of thyroidectomized rat heart immersed in Ringer solution at 36° C. is twice that of normal rat heart.

TABLE 2

Animals	No. of exp.	Heart glycogen gm. %	Loss of heart glyc. through chronic oxygen lack gm. %	Loss of heart glyc. through chron. oxygen lack in % of initial value	Muscle glycogen gm. %	Liver glycogen gm. %
Thyroidect.	15	0·250	0·113	31	0·27	1·92
Control	15	0·068	0·142	68	0·26	1·84

The markedly greater glycogen content of the heart of thyroidectomized rats is only slightly reduced by killing without narcosis through a blow on the neck (Stein, Tuerkischer, Wertheimer[2]). Chronic oxygen-lack affects the cardiac glycogen content of thyroidectomized rats to a lesser extent than it does the cardiac content of normal rats. Both treatments reduce the cardiac glycogen content of normal rat to a minimum. KCN and also caffeine have an identical effect on the heart glycogen of both thyroidectomized and normal rats. Thyroidectomy does not produce any of the above-mentioned deviations from normal in skeletal muscle.

The total creatinine content of the heart of thyroidectomized rats averages 23 per cent more than normal. Skeletal muscle of thyroidectomized rats gives normal creatinine values. Cardiac phosphagen and lactic acid content are not changed by thyroidectomy.

The specific nature of the changes produced by thyroidectomy in cardiac rigor, glycogen storage, and total creatinine content leads to the conclusion that removal of the thyroids affects the special metabolism of heart muscle in a manner which is not dependent on the depression of general metabolism by thyroidectomy.

L. STEIN.
E. WERTHEIMER.

Laboratory of Applied Physiology,
The Hebrew University,
Jerusalem.
June 23.

---

[1] Chang, St., Patras, M. C., and Templeton, R. D., *Amer. J. Physiol.*, **118**, 423 (1937).

[2] Stein, L., Tuerkischer, E., and Wertheimer, E., *J. Physiol.*, **95**, 356 (1939).

Drinking Habits of Animals

IN a recent publication[1], I made reference to a paper by Gregersen[2] in which he recorded that dogs, confined in cages and fed once a day, drank water from time to time during 2–5 hours after the meal and scarcely at all at other times of the day. I interpreted this to mean that the dogs did not drink water until an interval of two hours had elapsed after the time of feeding, whereas the charts shown in Gregersen's paper indicate clearly that the dogs drank water from time to time during the 2–5 hours *immediately* following the time of feeding. I wish to record my apology for my error.

Also, mention is made, in my paper already referred to, of the drinking habits of leopards kept in confinement and fed once a day on flesh. Further observations made on one such leopard showed that, although on several occasions it did not drink water after feeding until an interval of about 2 hours had passed, this was not a constant habit. The observed intervals, expressed in minutes, between the time of completion of a meal and the time of first drinking water thereafter were: 2, 6, 15, 50, 56, 115, 120, 121, 148.

A. BROWNLEE.

Lanark Road,
Juniper Green,
Mid-Lothian.
Sept. 30.

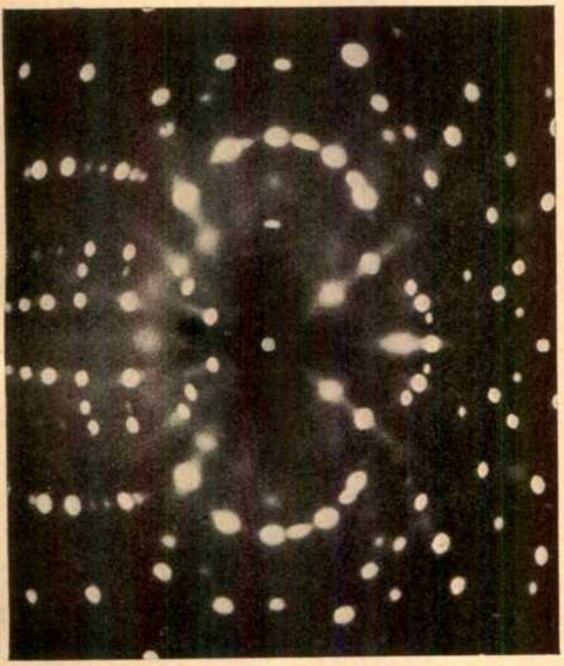
---

[1] Brownlee, A., *J. Comp. Path. and Ther.*, **53**, 55 (1940).

[2] Gregersen, M. I., *Amer. J. Physiol.*, **102**, 344 (1932).

Modified Reflection of X-Rays

As stated in an earlier communication[1], quantum theory leads to the remarkable conclusion that the reflection of X-rays in crystals is of two types ; first, the classical or unmodified reflections associated with the normal structure amplitudes of the crystal ; and secondly, the quantum or modified reflections which arise when the vibrations of the crystal lattice are quantum-mechanically excited by the incident X-radiation. The direction and intensity of the reflections of the second kind have been considered theoretically in a recent paper[2]. It is shown that when the energy taken up by the crystal lattice is in the form of *acoustic waves*, the recoil of the photon is observable as *a diffuse scattering* of the incident X-radiation, while on the other hand, when the *optical vibrations of the crystal lattice* are excited, the resulting effect is *a regular reflection* of the incident radiation.



MODIFIED REFLECTIONS WITH CALCITE.

The geometric law of quantum or modified reflection, shown to be experimentally valid by an extended series of measurements[3] with sodium nitrate and with rock-salt crystals, takes the very simple symmetric form $2d \sin \frac{1}{2}(\theta + \varphi) = n\lambda$, where d is a crystal spacing, and θ, φ are the glancing angles of incidence and reflection with respect to such spacing. The formula leads to the interesting conclusion that the angle between the incident and reflected rays is independent of the setting of the crystal though, as shown both by theory and experiment, the intensity of the reflection does depend on such setting.

TABLE I. 400 Modified Reflections observed with a Rock-Salt Crystal, $\lambda = 0·708$ A., $d = 2·814$ A.

θ	φ	$\theta + \varphi$	d (calculated) Symmetric formula	d (calculated) Asymmetric formula
9° 40′	19° 18′	28° 58′	2·83 A.	2·76 A.
11° 36′	17° 26′	29° 2′	2·82 ,,	2·78 ,,
17° 46′	11° 22′	29° 8′	2·82 ,,	2·85 ,,
19° 21′	9° 57′	29° 18′	2·80 ,,	2·85 ,,
25° 21′	3° 57′	29° 18′	2·80 ,,	2·89 ,,

Table 1 (fourth column) gives the spacings calculated by the stated formula from observations on the second-order modified reflections from the cleavage planes of a rock-salt crystal, and shows fair agreement with the known crystal spacing. It is given here especially to exhibit the fact that there is no such agreement between the actual crystal spacing and the values entered in the fifth column, which have been calculated from the formula :

$$d(\sin \theta + \cos \theta \tan \varphi) = n\lambda.$$

In the latter formula, φ indicates, according to Faxen[4] and to Zachariasen[5], the direction of maximum intensity in the diffuse thermal scattering of X-rays by a cubic crystal.

The well-defined character of the quantum reflections given by an ideal crystal is illustrated in the accompanying reproduction, which is a strongly exposed Laue pattern of calcite. It exhibits the modified reflections by numerous planes in the crystal including, especially, the first, second and third order reflections from the cleavage planes, the K_α and K_β spots being clearly separated.

C. V. RAMAN.
P. NILAKANTAN.

Department of Science,
Indian Institute of Science,
Bangalore.
August 18.

---

[1] NATURE, **145**, 860 (1940).
[2] Raman and Nath, *Proc. Ind. Acad.*, **12**, 83 (1940).
[3] Raman and Nilakantan, *Proc. Ind. Acad.*, **11**, 398, and **12**, 141 (1940).
[4] Faxen, *Z. Phys.*, **17**, 277 (1923).
[5] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).

Atomic Energy Values of Ionized Tellurium (Te II)

THE identification of the structure of the spectrum of singly ionized tellurium, briefly reported by one of us previously[1], has led to the following absolute values of the characteristic terms :

$5p\ {}^4S_{1\frac{1}{2}} = 173801$
${}^2D_{1\frac{1}{2}} = 163580$
${}^2D_{2\frac{1}{2}} = 160847$
${}^2P_{\frac{1}{2}} = 152281$
${}^2P_{1\frac{1}{2}} = 148101$
$6s\ {}^4P_{\frac{1}{2}} = 95352·6$
${}^4P_{1\frac{1}{2}} = 91057·5$
${}^4P_{2\frac{1}{2}} = 87704·4$
${}^2D_{1\frac{1}{2}} = 78944$
$\alpha = 71559$
$\beta = 83810$
$6s\ {}^2P_{\frac{1}{2}} = 89246·1$
$6s\ {}^2P_{1\frac{1}{2}} = 85375·8$
$6p\ {}^4D_{\frac{1}{2}} = 74458·6$
${}^4D_{1\frac{1}{2}} = 72811·2$
${}^4D_{2\frac{1}{2}} = 66515·4$
${}^4P_{\frac{1}{2}} = 77008·9$
${}^4P_{1\frac{1}{2}} = 74376·0$
${}^4P_{2\frac{1}{2}} = 70364·6$
${}^4S_{1\frac{1}{2}} = 65461·6$
${}^2P_{\frac{1}{2}} \doteq 73362·4$
${}^2P_{1\frac{1}{2}} = 68150·4$
${}^2D_{1\frac{1}{2}} = 71733·8$

The ionization potential of Te II, as determined from the largest term $5p\ {}^4S_{1\frac{1}{2}} = 173801$ cm.$^{-1}$, is 21·5 volts approximately. The detailed results will be published elsewhere.

K. R. RAO.
M. G. SASTRY.

Andhra University,
Waltair, India.
July 20.

---

[1] NATURE, **143**, 376 (1939).

RESEARCH ITEMS

Bony Growths in the Human Jaw

Certain secondary formations on the human jaw were first reported in 1884 by Danielli. Though noted repeatedly since by various scientific workers, they are still far from being generally known and understood. Aleš Hrdlička, in a recent discussion of the condition (*Amer. J. Phys. Anthrop.*, **27**, 1; 1940), has reviewed and analysed recorded observations and has added to them new data based upon an examination of 5,632 lower jaws—cases which offered no possible doubt as to the nature of the formation. These hyperostoses consist of various grades and forms of supplementary hard bony tissue above the mylo-hyoid line on the lingual surface of the mandible. They have no connexion with anything pathological, though they may, when overdeveloped, cause trouble mechanically. They do not as a rule develop in the higher apes. In man they occur sporadically from palæolithic times—they are reported in Sinanthropus—are more frequent in the neolithic period, and later grow more or less common in various human groups. They do not show any clear racial selectiveness, but are more common in the Yellow-Browns than in White or Black. This preponderance, however, appears more regional than racial. It is most marked in the northernmost or cold, least marked in the southern or warm, regions. A remarkable and instructive difference is seen to exist between the North American and the Old Peruvian Indians; in the latter the hyperostoses are almost wanting, while in the North Americans they are four times in number and even more in weight. The evidence furnishes a strong indication that the mandibular hyperostoses are neither of phylogenetic transmission nor show any plain racial heredity. Apparently they are brought about by environmental conditions, which can only mean food, and hence mastication. They tend to be both more frequent, and on the whole more strongly developed in the males. It is impossible to reach any conclusion other than that they are caused by stresses of mastication in excess of the capacity of the individual bones, and that they are the efforts of the organism to provide additional strengthening to the parts affected.

The English Sparrow in the United States

The common house-sparrow, introduced from England to Brooklyn (N.Y.) in 1850 and 1852, has long been established in the United States beyond the possibility of eradication. And the introduction and establishment are regretted, for the evidence gathered by a new investigation of the activities of the bird show that its harmfulness to agriculture outbalances whatever good it does. E. R. Kalmbach in his inquiry into the economic status of the sparrow examined the food content of 8,004 stomachs, a larger number than ever before employed in the study of the food habits of a single species of bird (U.S. Dept. Agric., Tech. Bull., No. 711; June 1940). Since the publication fifty years ago of Barrows' classic account of the sparrow in the United States, the range of the species there has more than doubled and the bird has come to be of economic importance in every State. It is admitted that in special localities and on special occasions sparrows have done notable service, for example, in destroying the alfalfa weevil in Utah in 1911 and 1912 or in destroying bark-beetles in a lumber-yard in Alabama in 1913–1915, but such beneficial activities are almost confined to the short period when the nestlings are fed on insects. They do not appear to counterbalance the real and potential harm with which the adults must be charged on account of their feeding activities. In addition, it is known that the sparrow is an agent in the transmission of certain poultry parasites and diseases. The author, however, does not advise ruthless slaughter; control measures should always be limited to the needs of the occasion, and it should be remembered that in cases of unforeseen insect plagues the sparrow may turn out to be a valuable helper in checking and suppressing the enemy.

Variation in the Bull- or Gopher-snakes (*Pituophis*)

In the first thorough attempt which has been made to analyse the variations in the snakes of the genus Pituophis, Olive Griffith Stull recognizes six species and thirteen "forms" (*U.S. Nat. Mus. Bull.*, **175**; 1940). This genus of conspicuous and well-known snakes ranges from Guatemala to Canada, including most of Mexico, all the United States west of the Mississippi, several to the east, and all Atlantic States from Alabama to New York, and everywhere it seems to be little restricted as to habitat. Comparison of the different forms in their geographical relationship shows that from the probable centre of dispersal outwards a general decrease in scale characters accompanied by an increase in proportionate length of tail occurs in all forms. Also in every form which is represented by a sufficient number of specimens there is a similar variational tendency in scale rows, ventrals, and caudals. As a rule decrease in scale characters within any form is correlated with general dwarfing, but this is not necessarily true for comparisons between different forms. Sexual variation is indicated by higher numbers of scale rows and ventrals in the females, and higher caudals, proportionate tail length and number of tail spots in the males.

X-Ray Radiation on Tradescantia Chromosomes

A. C. Fabergé (*J. Genetics*, **40**, 379–384; 1940) describes an experiment involving the radiation of chromosomes of *Tradescantia bracteata* by X-rays of differing wave-lengths. He shows that several checks on the accuracy of such an experiment may be made by statistical treatment; it is shown that in this experiment it is uneconomical to examine more than 18 cells per slide. The estimation of chromosome breaks was made by counting the number of bodies in the cell after radiation. No difference between the results of hard and soft radiation was found.

Cyto-genetics of Brassica

The genus Brassica contains species showing aneuploid chromosome numbers and is interesting from an evolutionary point of view. S. M. Sikka (*J. Genetics*, **40**, 441–509; 1940) has studied the chromosomes of several species and hybrids between them. *B. juncea* is an allopolyploid derived from the crossing of *B. campestris* and *B. nigra*. The hybrid between *B. tournefortii* and *B. trilocularis*, although both have $2n = 20$ chromosomes, has an irregular meiosis showing a quadrivalent, 1–3 bivalents or a lack of pairing in different nuclei. On the other hand, *B. rapa* × *B. trilocularis* shows 10 bivalents at meiosis. The correlation between the number of satellites and number of nucleoli was observed, while secondary association indicates that the basic chromosome number of the genus is five. Hybridization has played the most important part in the evolution of the genus.

Physiology of Storage in Bananas

A recent publication by C. W. Wardlaw (Mem. 15, Trinidad Low Temperature Research Station, May 1940), on the storage of Gros Michel bananas, centres around the possibility of transporting fruit from Trinidad by the use of refrigerated gas storage. The problem is to retard ripening without serious disturbance in the course of metabolism. The results obtained under laboratory conditions indicate that with suitable control of atmospheric conditions, bananas considerably heavier than "3/4 full" could be safely subjected to a journey of some 16 days with no deleterious effects on the fruit when afterwards ripened. Thus, when rapidly cooled to 53° F. in an atmosphere containing 5 per cent carbon dioxide and 5–7 per cent oxygen, considerable retardation of ripening is produced, in comparison with controls in air, with no evidence of chilling or gas injury. A carefully regulated series of experiments indicate these as the optimum atmospheric conditions. It is further suggested that this atmosphere could be maintained under storage, without recourse to artificial atmospheres, by the use of 'gas-tight' holds, carefully controlled ventilation and partial removal of oxygen by chemical means, and by control of the (vol. of fruit/vol. of hold) ratio. It is emphasized that fruit showing incipient ripening must be rigidly excluded, since the presence of even small quantities of such fruit tends to accelerate the ripening of immature fruit, probably by accumulation of physiologically active substances.

Composition of Coal

The resins and hydrocarbons which exist in small proportions in coal are of considerable importance in the caking properties. In the rational analysis of coal, these resins and hydrocarbons are extracted with pyridine but it is known that this extraction is incomplete: in the residue there is still a fraction dissolved by subsequent extraction with benzene under pressure. R. Belcher and R. V. Wheeler (*J. Chem. Soc.*, 866; 1940) have examined the use of quinoline (already used by Vignon in 1914) instead of pyridine as a primary solvent but find that it has no advantage over pyridine either in rapidity or completeness of extraction. With technical quinoline exposed to daylight there is also a possibility of the photochemical formation of material liable to be confused with the true extract.

Phosphonium, Arsonium and Stibonium Salts

J. Chatt and F. G. Mann (*J. Chem. Soc.*, 1192; 1940) have shown that tetraphenylarsonium salts can be obtained by the action of aluminium chloride on (1) arsenic trichloride and benzene, (2) phenyldichloroarsine, (3) diphenylchloroarsine, (4) triphenylarsine, (5) triphenylarsine and bromobenzene, the best yield being obtained in (5). Tetraphenylphosphonium and tetraphenylstibonium compounds can be obtained by methods analogous to (5). The tetraarylstibonium salts were hitherto unknown. The reactions evidently follow a complicated mechanism, involving the migration of phenyl radicals.

Constitution of Pectic Acid

The structure of a pectic acid or polygalacturonic acid prepared from citrus pectin by treatment with dilute hydrochloric acid has been examined by Miss S. Luckett and F. Smith (*J. Chem. Soc.*, 1106, 1114; 1940). By methylation with methyl sulphate in presence of alkali, precipitation of the thallium salt of the methylated acid, and reaction of this with methyl iodide, the methyl ester of the methylated pectic acid was obtained as a solid. Hydrolysis of this with methyl-alcoholic hydrogen chloride gave as the main product the methyl ester of 2 : 3-dimethyl galactofuranoside, the structure of which was confirmed by its oxidation to 2 : 3-dimethyl mucic acid with silver oxide and methyl iodide, and also by the formation of the methyl ester of 2 : 3 : 5-trimethyl β-methyl galactofuranoside, which after oxidation gave the γ-lactone methyl ester of 2 : 3 : 5-trimethyl mucic acid. Citrus pectic acid is thence supposed to be composed of pyranose residues of galacturonic acid joined by 1 : 4-α-glycosidic links. The molecule of the methyl ester of methylated pectic acid appears to be relatively small, the size as determined by osmotic pressure measurements being about 13 units. The methyl ester of 2 : 3 : 5-trimethyl β-methylgalactofuranoside was synthesized from methylgalactofuranoside and its structure determined by its conversion into the crystalline γ-lactone ester of 2 : 3 : 5-trimethyl mucic acid. Some derivatives of 2 : 3 : 5-trimethyl galactonic acid were isolated in a crystalline state.

Basic Nature of Vanadium Pentoxide

Although vanadium pentoxide V_2O_5 is a typical acidic oxide giving rise to series of salts (the vanadates) with bases, it has been known since the time of Berzelius that it is considerably more soluble in acids than in water, so that it also shows basic properties. Some solid compounds with sulphuric acid have been reported. These have been re-examined by O. E. Lanford and S. J. Kiehl (*J. Amer. Chem. Soc.*, **62**, 1660; 1940), who find that only the solids $V_2O_5, 4SO_3, 4H_2O$, $V_2O_5, 2SO_3, 3H_2O$ and $V_2O_5, 2SO_3, 8H_2O$ are formed at 30°, no indication being found of the two compounds described by Berzelius. H. T. S. Britton and G. Welford (*J. Chem. Soc.*, 895; 1940) have examined the solubility of vanadium pentoxide in solutions of acids. The solubility depends on the strength of the acid and the temperature. Hydrochloric, nitric, perchloric, sulphuric, acetic and trichloracetic acids, and sodium hydrogen sulphate were used at temperatures of 180° and 100°. The action of acids in precipitating vanadium pentoxide from solutions of sodium vanadate was also examined, in this case at the boiling point, when reproducible results could be obtained, the oxide held in colloidal suspension being then precipitated. The results show that V_2O_5 is amphoteric and is an extremely weak base. Even in the presence of excess of acids it does not show a basic function extending beyond the ion VO_2^+. The specific conductivities and freezing points of acid solutions of vanadium pentoxide were also measured; the conductivities fell and the freezing points rose slightly as the vanadium pentoxide content increased.

RELATION OF MUSEUMS TO COMMERCE

By Dr. Walter E. Collinge,
The Yorkshire Museum, York

Commercial Museums

COMMERCIAL museums are no new idea. Spain has long had one at Mataro, there is one at Lima in Peru, and another at Santiago in Chile, and others in Mexico, Brazil, and Japan; but the finest of all perhaps is that at Philadelphia. It arose out of the World's Columbian Exposition at Chicago in 1893. The vast exhibits there shown were secured and a permanent Board of Trustees and an Advisory Board appointed. This latter exercises a general supervision over the administration of the Museum with the object of furthering its development and fostering the efficiency of its service in the interests of commerce. Finally, there is a Diplomatic Advisory Board consisting of representatives of all foreign nations in the United States, with the object of ensuring international co-operation. In the first four years of its existence the city of Philadelphia provided £100,000 for the Museum.

The work is carried out in two separate departments, namely, a scientific department and a bureau of information. The former is concerned with the collection and exhibition of the raw products of the world, and the analysis and examination of all such materials. There is also an extensive exhibit of foreign manufactures, which shows samples of merchandise now being sold in foreign countries, especially in the markets of South America, Australia, South Africa, and other promising fields. The object is to show the American manufacturer what his competitors are doing in the foreign trade of these countries, and to suggest to him new lines of goods which he may produce and sell with profit.

The practical value of this department will at once be recognized. The manufacturer of cotton goods, for example, who is desirous of wider markets for his products, may here find thousands of samples, showing him in the greatest detail the styles of goods which are now being sold. He may inform himself concerning the weights, widths, lengths, and patterns which are in favour. Each sample is accompanied by the manufacturer's price. With this information the American manufacturer is put in a position to judge of any market as to whether it would be worth while for him to attempt to claim a share of its trade. Equal facilities are offered to manufacturers of hardware and cutlery, boots and shoes, hats, caps, woollens and many other lines of products. Novelties and improvements made by foreign manufacturers in standard goods and staples are promptly noted. By frequent additions this collection is equipped to give a good idea of important changes in the demand for any line of commodities.

The Bureau of Information consists of a reading-room provided with technical and trade journals, with the contents indexed; consular and trade reports; an index of firms, etc.

For many years past there has been a constant inflow into the Bureau of Information regarding foreign markets, foreign trade methods and foreign business houses. There is a collection of technical dictionaries, foreign catalogues, a Language Translation Department, a library of 4,500 volumes and 79,000 pamphlets, including the commercial statistics of more than a hundred Governments. Files of official tariffs, custom house regulations, banking methods, registration of trade marks, and commercial practices for all countries are also included.

The Commercial Museum covers a floor space of about 2½ acres, and the exhibits show the commercial products and the chief industries of all countries, and also illustrate the manners and customs of various races of men.

Many of the exhibits are arranged by countries, separate sections being assigned to Mexico, Brazil, Argentina, Peru, Bolivia, Chile, Cuba and other parts of the Western Hemisphere. In a like manner there are separate exhibits of larger size devoted to South Africa, Central Africa, North Africa, India, Japan, China, and the South Sea Islands. All these exhibits contain authentic samples of commercial products which are constantly being used for the help of American business men.

A separate series of exhibits, covering a large floor space, is devoted to classified collections of products. Here the visitor will find all the varnish gums brought together for the purpose of comparison, whether they come from America, Africa or the Far East. In another collection all the commercial varieties of cotton are displayed, whether grown in the United States, Brazil, Egypt, or India.

There are systematic collections of this kind illustrating such products as corn, wheat, sugar, tea, coffee, flax, silk, wool, gums, and resins, rubber, furs, leather, coal, petroleum, etc.

Exhibitions

At different times and in different places there are held great exhibitions and fairs, such as those in London, Glasgow, Paris, Toronto, etc. Taken more seriously these might be made very useful and of great commercial value; but there is so much irrelevant matter introduced, and with better arrangements and greater pains taken in the art of exhibiting they might be greatly improved. In the United States, the administration and organization of such exhibitions is entrusted to a Board on which two or three individuals possessing a sound experience of museum administration and organization sit.

Training of Craftsmen

In British-made goods we not infrequently find an inferiority in design and artistic skill when compared with those of other countries. The workmen are not familiar with the masterpieces and the work of the great craftsmen. There is a lack of appreciation of symmetry, form, colour, design, etc. Unless we can quicken the mental life of the people and provide them with easily accessible standards of reference of the very best, both in the industrial and fine arts, we shall continue to fall behind. We must place before the rising generation the best that has been produced in the past and the best that is being produced to-day, and this will form the right basis on which they will build for the future. It is in our art galleries and museums that this can be done best.

Man is an imitator and inventor, and his intellectual outlook and future is largely determined by his environment; he assimilates ideas from his surroundings and from these reconstructs new things. It therefore behoves us to provide the community with the highest and most perfect standards of reference. Our museums and art galleries must play a part in the normal life of the people. From the earliest school days right on through life these institutions should be made a source of interest, pleasure, and inspiration to all.

In woodwork, metalwork, stonework, and textiles, the museum can assist the craftsman in his technique. It can interest him in the past history of his craft, and as a result he will bring new ideas into his work, and such, of course, have a commercial value.

Speaking a few years ago to the National Association of Art Masters, the President said: "As an industrial nation, our very existence, as well as our prosperity, depends on our commercial enterprise. Therefore it is our duty to consider that aspect of the case, and find out how best Art Education can be brought into closer touch with the requirements of trade and the manufacturer, because when technical skill has done its best, it is the applied art that often determines the market value of the manufactured article. There is hardly a single marketable commodity that is not touched by art at one point or another before it reaches the purchaser."

Incidentally an ethnographic museum can be made of great assistance to industry. How often do we hear of and see manufacturers sending abroad textiles with designs that offend the susceptibilities of the natives or which are opposed to their superstitions or religious beliefs, whereas a very short study of the native-made mats, baskets, etc., would have shown the designs which are appreciated and in use.

"You will do the greatest service to the state," wrote Epictetus, "if you shall raise, not the roofs of the houses, but the souls of the citizens: for it is better that great souls should dwell in small houses rather than for mean slaves to lurk in great houses."

In our modern system of education "We strain the memory instead of cultivating the mind," as Lord Avebury said.

The objects in a commercial museum should awaken imagination, stimulate intelligence and inquiry, and place a higher and a truer conception of beauty before the visitors. The very environment should act upon the individual.

It is the museum and the art gallery which will cure our blindness. It is not necessary or good for us to walk about this world in a house that is dark, with eyes that see not, and here is the evil of the present day. We have a vast concourse of people who have been instructed but not educated. Lord Avebury some thirty-seven years ago wrote: "I fear that our present system does not really train the mind, or cultivate the power of observation, or even give the amount of information which we may reasonably expect from the time devoted to it."

COSMIC RAYS AT HIGH ALTITUDES*

By William P. Jesse,
University of Chicago

During the past year the cosmic ray investigators at the University of Chicago have carried out three different experiments to investigate some of the interesting phenomena associated with cosmic rays at altitudes of twenty thousand feet and higher. Marcel Schein and E. O. Wollan in collaboration with the author have been able by coincidence counter apparatus carried by balloons to determine as a function of altitude (1) the vertical intensity of the mesotrons in the atmosphere, and (2) the number of mesotrons generated in a block of lead 2 cm. thick by non-ionizing radiation. The mesotron intensity was found to increase rapidly with altitude up to a maximum value at about 6·6 cm. pressure and then to decrease. The production of mesotrons in the lead block becomes noticeable at an altitude of 5 km., and from this point on increases with altitude at about the same rate as does the soft component of cosmic rays.

In a second high-altitude experiment, by G. Herzog, a counter-controlled cloud chamber and magnet were carried in an aeroplane to a height of 29,000 ft. to obtain photographs of slow mesotron tracks. Mesotrons can be distinguished from electrons in a cloud chamber by reason of the increased ionization along the tracks only when the momentum of the mesotron lies within a range of relatively low values. Mesotrons of such low momentum values occur so rarely at sea-level that from thousands of cloud chamber photographs made at the surface of the earth not more than a dozen tracks have been clearly distinguished as mesotron tracks, and mass estimates made. Above twenty thousand feet such slow mesotrons were found by Herzog in much greater abundance. From 230 photographs obtained, more than twelve tracks could be definitely identified with the passage of a mesotron.

A third experiment, by the author, has consisted of a series of thirteen balloon flights in which an ionization chamber was carried up to an altitude of approximately 25 km. in an attempt to determine a possible time variation in the total intensity of cosmic rays near the top of the atmosphere. Time changes of more than fifteen per cent have been observed during the past year. Such changes follow quite closely the 'world-wide' variations of Forbush and others and are probably due, in part at least, to intensity changes in the magnetic field surrounding the earth. However, when the high-altitude values are corrected on the basis of ground values for the 'world-wide' variations, a residual effect remains with a maximum in the early spring and minimum in the late summer. Further experiments are necessary to determine whether this is a true seasonal effect.

---

* Substance of a paper read at the annual meeting of the U.S. National Academy of Sciences held during April 22–23.

FORMATION OF 3/2 ELECTRON COMPOUNDS IN ALLOYS OF COPPER, SILVER, AND GOLD

In many alloys of copper, silver, and gold with the elements of the *B*-sub-groups, the phase next to the α solid solution has a composition near that required by an electron concentration of 1·5, and for convenience these may be called the 3/2 electron compounds. The crystal structures of these are of three types: (1) body-centred cubic structures, either disordered (β) or ordered (β′); (2) close-packed hexagonal types (ζ or ζ′); (3) β-manganese type (denoted μ).

A review of the existing data by W. Hume-Rothery, P. W. Reynolds and G. V. Raynor (*J. Inst. Metals*, **66**, 1940), shows that the 3/2 electron compounds are formed only when the size-factors are reasonably favourable, the term 'size-factor' being used to denote the difference between the atomic diameters of solvent and solute. A detailed examination leads to the following generalizations: (*a*) increasing valency favours the ζ or μ structures at the expense of the β or β′ structures; (*b*) increasing temperature favours the β structures at the expense of the β′, ζ, or μ structures; (*c*) increasing size-factor favours the β structures at the expense of the ζ or μ structures; (*d*) increasing the size-factor moves the composition of the 3/2 electron compounds in the direction of lower electron concentration, and also narrows the range of composition of the phases in terms of electron concentration; (*e*) the tendency to form ordered β′ structures in copper, silver, and gold alloys is in the order gold > silver > copper.

A review of the data shows that considerations of size-factor and electron concentration are not by themselves sufficient to explain the facts, but that an additional factor is present to an increasing extent, as the solvent and solute metals differ in their electrochemical properties. In their alloys with electropositive metals (such as magnesium or zinc), copper, silver, and gold are the electronegative members, and the electrochemical factors are in the order gold > silver > copper. In alloys with the electronegative elements (such as arsenic), copper, silver, and gold are electropositive, and the electrochemical factors are in the reverse order, copper > silver > gold. This reversal of the relative electrochemical nature of the solvent and solute takes place at about Group IV.

The tendency to form the β′ structures with long-range order is favoured by an increasing electrochemical factor, and, when this is sufficiently pronounced, the β′ liquids and solidus curves rise to a maximum, as in the system gold-magnesium. A consideration of the effect of the development of long-range order on the form of the equilibrium diagram leads to an explanation of the form of the copper-beryllium diagram. An examination of the phase boundaries of the equilibrium diagrams shows that, in many cases where the percentage of the solute is high, the diagrams begin to acquire characteristics that would be expected in ordered structures, even though X-ray investigations show that long-range order does not exist. It is suggested that a short-range order may be present, and it is shown that this conception accounts for the shapes of parts of the equilibrium diagrams, and for the limiting compositions to which some of the phase boundaries approach.

FORTHCOMING EVENTS

Tuesday, October 22

Illuminating Engineering Society (at the E.L.M.A Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 2.30 p.m.—Mr. H. C. Weston: "Industrial Lighting and the Black-out."

Wednesday, October 23

North-East Coast Institution of Engineers and Shipbuilders (Student Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 6.45 p.m.—Mr. George Wright, jr.: "Relative Merits of Marine Fuels". (Chairman's address).

Thursday, October 24

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m. —Mr. J. R. Beard: Presidential address.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1939. (Twenty-fifth Report.) Pp. vi+132+6 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [710

British Electrical and Allied Industries Research Association. Technical Report, Reference L/T 114: The Electric Strength of Solid Dielectrics in relation to the Theory of Electronic Breakdown. Pp. 18+9 plates. (London: British Electrical and Allied Industries Research Association.) 3*s*. [810

Other Countries

Field Museum of Natural History. Botany Leaflet 25: The Story of Food Plants. By B. E. Dahlgren. Pp. iv+33. (Chicago: Field Museum of Natural History.) 25 cents. [710

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 15: A Symposium on Social Progress. What is Social Progress? by L. J. Henderson; A Paper on Social Progress, by Crane Brinton; Social Progress, by Edwin Bidwell Wilson. Pp. 457–472. (Boston: American Academy of Arts and Sciences.) 50 cents. [710

Smithsonian Miscellaneous Collections. Vol. 99, No. 6: The Time Course of Photosynthesis and Fluorescence observed Simultaneously. By E. D. McAlister and Jack Myers. (Publication 3591.) Pp. ii+37. (Washington, D.C.: Smithsonian Institution.) [710

U.S. Department of Agriculture. Technical Bulletin No. 732: Arsenic Distribution in Soils and its Presence in Certain Plants. By Kenneth T. Williams and Richard R. Whetstone. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents. [710

Smithsonian Institution: United States National Museum. Bulletin 100, Vol. 14, Part 1: Contributions to the Biology of the Philippine Archipelago and Adjacent Regions—Report on the Echinoidea collected by the U.S. Fisheries Steamer *Albatross* during the Philippine Expedition 1907–1910, Part 2: The Echinothuridæ, Saleniidæ, Arbaciidæ, Aspipodiadematidæ, Micropygidæ, Diadematidæ, Pedinidæ, Temnopleuridæ, Toxopneustidæ and Echinometridæ. By Theodor Mortensen. Pp. iv+52. (Washington, D.C.: Government Printing Office.) 10 cents. [710

Indian Forest Records (New Series). Silviculture, Vol. 4, No. 1: Canadian Aerial Forestry for Burma. By J. D. Braithwaite. Pp. ix+96+18 plates. (Delhi: Manager of Publications.) 3.12 rupees; 6*s*. [710

United States National Museum. Bulletin 176: Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds and their Allies; Orders Psittaciformes, Cuculiformes, Trogoniformes, Coraciiformes, Caprimulgiformes and Micropodiformes. By Arthur Cleveland Bent. Pp. viii+506+73 plates. (Washington, D.C.: Government Printing Office.) 75 cents. [810

Canada: Department of Mines and Resources, Mines and Geology Branch: Geological Survey. Paper 40–1: Preliminary Map, Jumpingpound, Alberta. By G. S. Hume. 1 map. 10 cents. Paper 40–6: Preliminary Map, Bragg Creek, Alberta. By G. S. Hume and H. H. Beach. 1 map. 10 cents. Paper 40–8: The Structure and Oil Prospects of the Foothills of Alberta between Highwood and Bow Rivers. By G. S. Hume. Pp. iii+22+1 map. 10 cents. Paper 40–10: Stony Rapids and Porcupine River Areas, Saskatchewan. By G. M. Furnival. Pp. ii+10+2 maps. 10 cents. Paper 40–11: The Lloydminster Gas and Oil Area, Alberta and Saskatchewan. By G. S. Hume and C. O. Hage. Pp. iii+12. 10 cents. Paper 40–12: Zeballos Mining District and Vicinity, British Columbia. By M. F. Bancroft. Pp. iii+39. 10 cents. Paper 40–14: Quyta Lake and Parts of Fishing Lake and Prosperous Lake Areas, Northwest Territories. By A. W. Jolliffe. Pp. iii+9. 10 cents. (Ottawa: King's Printer.) [810

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704

FOOD SUPPLIES AND NUTRITION IN EUROPE

WITH the approach of winter, the problem of food supplies and nutrition in Europe is receiving much attention. Already it is clear that difficulties will have to be faced, and that they will present a major problem on the conclusion of hostilities. But the problem is, in fact, only a part of the much wider question of the planning of relations between food-importing and food-growing countries so as to clear the channels of trade, to regulate its even flow and to remove the arbitrary interference of national or individual self-interest. In his preliminary report to the Economic Committee on Standards of Living, Prof. N. F. Hall suggested that the principal need was a large variety of improvements and reforms, many of them small in themselves, but with cumulative effect through more or less simultaneous action by many Governments of very greatly increasing world economic activity. The intensification of Government efforts to increase efficiency and the reduction of costs in both production and distribution is an important means of progressively raising standards of living; and, particularly in regard to food production and distribution, measures forced upon us as part of our food policy in war-time may offer the prospect of considerable immediate advance after the War. The recent scheme for free or cheap milk in Britain represents the latest development of a policy begun tentatively before the War to increase the consumption of the protective foods, dairy products and fruit, of which the poor consume so much less than the richer classes.

It should be recognized, moreover, that the power which our blockade of Germany puts in our hands entails a special obligation of the British people to Europe. The power of the British blockade must be used not only to defeat the enemy of freedom in Europe but also to help Europe to restore and reorganize her strength and to create a unity of life and purpose. The fatal mistake of suspending at the end of the War of 1914–18 such organizations as the Allied Maritime Transport Council and the Supply Council must not be repeated. Mr. Bryant's haunting picture of famine over Europe in his recent book "Unfinished Victory" should ever be in our minds when we are tempted to face the peace unprepared.

So far as Germany itself is concerned, the effects on public health of the Nazi regime are described by Dr. Martin Gumpert in his recent book "Heil Hunger"*. The record affords a striking parallel to the picture of labour under Nazi rule which Dr. W. A. Robson drew in a recent Oxford Pamphlet. While the deterioration of intellectual activity in Germany in the last seven years as an outcome of the proscription of freedom of thought, teaching and speech is widely known, the price which has been paid in physical health for the Nazi achievements is far from being appreciated. Dr. Gumpert, like Dr. Robson, shows that even the "Strength through Joy" movement has an uglier side, and his book should supply a corrective, if any were still needed in Great Britain, to the perspective in which the methods by which even undoubted progress has been secured are viewed.

Dr. Gumpert's figures have been severely criticized by Dr. W. A. Brend in an article in the *Nineteenth Century*, and it is true that Dr. Gumpert has failed to present his statistics in comparison with those of other European countries. His assertion that six years of Nazi rule have led to an increased death-rate and a falling birth-rate is flatly contradicted by Dr. Brend, who maintains that in some respects health conditions in Germany are ahead and in others only a little behind other leading European nations. Dr. Gumpert's statistics, however, are the least impressive feature of his book. Much more significant and impressive are the quotations from official German publications indicating concern with the results of policy or a deliberate disregard of considerations of health and welfare.

---

* Heil Hunger! Health under Hitler. By Dr. Martin Gumpert. Translated from the German by Maurice Samuel. Pp. 128. (London: George Allen and Unwin, Ltd., 1940.) 5s. net.

In spite of efforts to improve the health and working capacity of German students, the numbers of those physically inadequate steadily increases. Under-nourishment is officially admitted, simultaneously with the recommendation that those who are physically fit for sport should be excluded from courses of study. The systematic demand for over-exertion, the abrogation or evasion in various ways of the restrictions on child labour which had existed in Germany for decades, and the deterioration of standards of education, have already had dire consequences on the youth of the nation.

Equally sombre is the picture of the ruin of science drawn by Dr. Gumpert. With the outlines of this scientific workers are already familiar, but his chapter under this heading is more concerned with the way in which the standards of medical training, research and practice have been relaxed, opening the door to quackery and threatening a shortage of trained personnel. The impressive decline in the numbers of university students has been accompanied by a neglect and decay of vital physical and intellectual values in Germany which have already affected the military power of the country and its capacity for war.

It would be unwise to exaggerate the significance of this effect, but Dr. Gumpert clearly indicates that during six years of Nazi rule, Germany has been under the stress and strain which are associated with war rather than peace, with the usual effects on health. The really significant part of the book lies in those chapters in which, dealing with food consumption and diet, agricultural policy and the like, Dr. Gumpert indicates that Germany is to-day in the condition of a nation which has been carrying on an exhausting war for six years. The under-nourishment which exists in Germany is not comparable with the deprivation which reigned there in the latter part of the War of 1914–18 and afterwards. Its inroads on health are more insidious but may be equally far-reaching, and Dr. Gumpert refers to a memorandum in 1938 in which leading scientific men such as Abderhalden, Kuhn and others directed the attention of the Reich Government to the shortage of vitamin B in the food of the German people and to the need for a larger supply of fresh fruit and vegetables to safeguard the public health.

To what extent the position has been relieved by German expansion and the ruthless exploitation of the occupied territories during the past year is problematic. Even after the absorption of Austria and the Sudetenland, official spokesmen asserted that a 25 per cent increase in agricultural production was necessary for complete independence in food supply. The dependence of Denmark and Holland on imported feeding stuffs should prevent Germany from reaping more than temporary advantage from her despoilation of those countries.

The position appears to resemble that which developed towards the end of the 1914–18 period sufficiently closely to warrant the conclusion that Germany herself will be in no less need of relief than the occupied territories when Nazi domination is overthrown. It will be remembered that in undertaking to encourage the building up all over the world of food reserves destined for the relief of countries held by Germany, Mr. Churchill was careful to include the people of Germany itself and of Austria. The planning of post-War relief in this way might well be used by the Ministry of Information to develop more effective relations with the submerged democratic movements abroad, to strengthen them in their resistance to Nazi tyranny and to prepare the way for corporate planning after the War.

Such a task will involve the handling of the world's accumulated surpluses of primary products, which already represent a standing problem of modern world economy, exaggerated by the abnormal conditions of the War. The exportable surpluses of wheat in overseas countries may well exceed a thousand million bushels. Management of this problem is part of the larger problem of the re-organization of the world's agriculture and the direct treatment of poverty and malnutrition. To prepare now for this task, and to extend the survey to other aspects of European reconstruction —to problems of transport, of housing and public works, and of industrial reconstruction—would be a prudent anticipation of needs which must be met whatever political shape a liberated Europe may assume. It may indeed well prove that concentration on such aims—an improved level of nutrition, higher standards of living, a more prosperous world agriculture, freer international trade and an increased volume of trade—interlocked as they are, may make a practical contribution to the future world order by affording opportunity between armistice and final settlement for passions and prejudices to die down, issues to be clarified and international understanding and co-operation to be fostered.

This approach to the economic needs of Europe cannot be made in isolation from the needs of Great Britain. The main responsibility for the defence of civilized Europe rests on Britain. The power that is ours carries also the responsibility for the initiative for the building up of a new Europe. As we recognize and discharge these twin responsibilities, we shall find that many of the solutions to our present problems of defence hold the key to the solution of post-War problems of reconstruction and readjustment, and that the policies best calculated to meet our own post-War needs are essentially part of wider policies designed, in co-operation with the Dominions and with the United States of America, to restore order to Europe, to relieve her necessities and to stimulate a new and progressive era of welfare and freedom.

NATURE AND PSYCHE

The Idea of the Soul in Western Philosophy and Science

By Dr. William Ellis. Pp. 314. (London: George Allen and Unwin, Ltd., 1940.) 12*s*. 6*d*. net.

THIS is a book of unusual interest. Many writers have discussed the influence which the investigations and theories of natural science have had on our notions of 'mind', 'soul' or 'spirit', but Dr. Ellis has had the brilliant idea of treating the question the other way round; of tracing historically the influence that the notion of the soul has had on the development of science. He has no difficulty in showing that the influence has been decisive at certain critical stages and has left indelible marks on the thought and language of western Europe.

The first point he makes (following A. E. Crawley in his "Idea of the Soul") is that this European notion of the soul is not primitive. For primitive man the 'soul' of anything—man, beast, or stone—is simply the mental image of it. When the nineteenth-century anthropologists attributed 'animism' to primitive man, they were simply reading in their own ideas and attributing to him distinctions which he is incapable of thinking and which his language cannot express. ". . . Animism, in the sense of a belief in the spiritual nature of the universe, is not a naïve, but on the contrary, a highly sophisticated view; indeed the mere conception of *spirit*, as we understand it and as the anthropologists of the last century understood it, was unknown before the Platonic, or Christian, idea of the soul. Animism in the sense we have defined could not in fact have existed before Socrates' discovery of the immaterial concept" (p. 92).

The Socratic or Platonic view is that there is on one hand a changing world of sensuous appearance, to which belong the human body and its passions, on the other the eternal world of forms, to which belong the human reason as displayed in theoretical knowledge and moral intuitions and also the mind of God. The first of these worlds, because it is changing, is only half real. In a famous passage in the "Phædo", Socrates contrasts the account that could be given of his sitting in prison waiting for death in terms of the position and motions of his 'bones and sinews', that is to say in terms of a behaviourist theory of physical causes, with what he considers the true account in teleological terms. "It was because he conceived himself as two beings, a corpse or puppet on the one hand, actuated by a detachable ghost on the other, that Socrates found behaviourism unthinkable" (p. 295). As Dr. Ellis points out, Socrates very unfairly fathers the behaviourist theory on Anaxagoras, because prior to Socrates himself the distinction between a material world of mechanical causation and an immaterial world of ends had not been drawn. Of late, behaviourism seems to have had its revenge on Socrates; but the manner in which that has come about is the result of the peculiar twist which the seventeenth century gave to the prevailing Socratic-Platonic tradition, largely owing to the influence of Descartes.

The material world for Descartes was entirely real but also entirely dead and possessed none but mathematical properties, but for that reason was amenable throughout to scientific investigation. The Cartesian view, in fact, provided a stimulus to science which was lacking in the Platonic. The sensible qualities of things, like colours and sounds, belonged to the material world for Plato, but for Descartes were mental and therefore immaterial and in themselves inaccessible to science. The experimental method of science consists in determining general (preferably mathematical) relations between certain abstractions from perceptual experience; but it is only the abstractions and their mathematical relations that enter into the scientific account. Again the Cartesian view offers no difficulties initially. Almost at the birth of science Pythagoras found that musical intervals corresponded to certain numerical ratios, by plucking a stretched string stopped off at different lengths. In principle the experimental method can do nothing more than Pythagoras did: it remained only to exploit the method to the full in all possible regions of experience. This has now been done to a very large extent, but under the influence of Cartesian rather than Socratic ideas. However, the behaviourist method, which Socrates rejected, has successfully invaded what was considered the stronghold of the soul, conscious and intelligent behaviour. Naturally the exploration of living and conscious organisms by physical methods reveals nothing that is not physical. If vitalists, such as Driesch, deny this, the denial is self-contradictory.

From the point of view of scientific method there is everything to be said for behaviourism and nothing against it, but when it becomes philosophy on Cartesian lines there are certain difficulties. ". . . The function of 'scientific' theories is to explain the perceptively known in terms of the perceptively known. As soon as the philosophical behaviourist calls the perceptively known world (or rather abstractions from it) the 'physico-chemical' world, and then tells us he can explain experience in terms of the physico-chemical he has embarked on a task which metaphysics may or may not be able to achieve, but which science, from the nature of the case, cannot even attempt. For the fact of perceptual knowledge cannot be grounded in the perceptively known. Any attempt to find the ontological ground of perception in the perceptively known is a project, like that of lifting oneself by one's own boot-straps, doomed to self-refutation" (p. 266). The source of the trouble is that the mind which perceives and thinks has been treated as an epiphenomenon by the Cartesian tradition. We are asked to believe ". . . that thinking is in some sense unreal and that only matter is real, because thinking tells us that matter causes thinking" (p. 269). The trouble remains whether it is said, with the naive realist, that colours and smells somehow belong to the surfaces of material objects whether or not any one is looking or smelling, or whether it is said that matter itself has no perceptible qualities, in which case it is entirely unknown and unknowable. No compromise between these two views is possible; either matter is exactly as it appears or it does not appear at all. Positivism again, which is only "a misplaced application of scientific method" (p. 286), is no solution of a problem that cannot be dealt with by that method.

Dr. Ellis states his problem with admirable clarity. The methods of experimental science must be pursued rigorously to the very end. No metaphysical fiat of "thus far and no farther" can stop them. On the other hand, scientific method solves no metaphysical problems, and the problems of how we apprehend the world revealed by science and what that world is still remain. Platonic or Cartesian dualism makes a solution impossible. But, whatever our decision as to the nature of the material world may be, it depends on our decision as to the nature of the mind or soul and also as to the nature of the organism that links it to the material world. Dr. Ellis only sketches in rough outline his suggestion for a solution, and his account is not easily summarized without unfairness. It must suffice to say that, as a biologist by training, he is first of all concerned to contradict Descartes, for whom matter was necessarily dead, and to establish a position much more akin to Leibniz—and also to such present-day views as Prof. Whitehead's "philosophy of organism" or Prof. Stout's "animism". The life of any organism consists of interchange and reciprocal relations with the environment. If there is any truth in saying an organism is alive, then it cannot be true that the environment is quite dead. The other main point Dr. Ellis makes is that there must be a hierarchy of forms or systems in Nature such that the higher, though not entirely disparate from the lower, display characters not apparent in the lower. The view is not unlike the doctrine of "emergents" elaborated by Alexander. It also leads him to the Leibnizian conclusion that matter is momentary mind, that is to say, what mind would be reduced to if it lacked all memory and foresight.

The one serious defect of the book is the unfair and indeed scurvy treatment of Aristotle. Admittedly his views did not greatly influence the main European tradition and admittedly they are confused by cross currents of Platonism, but he did attempt something better than the notion of a "corpse or puppet actuated by a detachable ghost". It would not be altogether unjust to call Dr. Ellis's own conclusion Aristotelian. There are a number of minor defects in the book. They include some irritating misprints, a certain slackness in giving references to the less-known authors mentioned and a few loose and excessively sweeping statements. A useful addition would have been some treatment of the post-Socratic attempts to give a purely materialist account of the soul. However, these are small blemishes in a most valuable work.

A. D. RITCHIE.

INTROVERTED SCIENCE

The Integration of the Personality
By Dr. Carl G. Jung. Translated by Stanley M. Dell. Pp. iv+313. (London: Kegan Paul & Co., Ltd., 1940.) 15*s*. net.

It will be interesting to see how this book with its steady introverted illumination of the psychic interior succeeds in overcoming the mental black-out of the War. Its main contents first saw the light in an ideal setting on the lovely edge of Lake Maggiore a mile or two from Ascona. The place, the speakers, the enthusiastic and hospitable convenor and the company of people all contributed to the making of a unique spiritual atmosphere in which inner realities could be discussed in their own right. These papers need to be read with this setting in mind. Prof. Jung is telling all those who are interested what the process of individuation actually consists of and what it involves as a real-life adventure. But he is also, and first of all, a great empirical man of science, and is therefore concerned to display this rather special field with scientific objectivity and detachment.

The first lecture is concerned with the meaning of individuation as a general psychological process; the process which aims at making a human being "a unique indivisible unit or 'whole man' ". This comprehensive introduction to the subject is followed by a short study of a patient who began spontaneously to paint her symbolical way towards the centre. The author then gives an excellent description of the principal figures or archetypes of the collective unconscious through which the psychic realm of the non-ego is experienced. These introductory chapters are clearly not intended to give an exhaustive description of the phenomenology of individuation. Rather one gets the impression that the author is outlining the ground-plan of the science of being, leaving the elaboration of the main edifice for a fuller work.

In effect, individuation is a solitary experience: it is therefore not everybody's medicine. It must be admitted that in so far as the experience remains irrelevant, this book will seem unintelligible. There are many for whom the idea of psychic value, the treasure difficult of attainment, the "purple hall of the city of jade", the "golden flower", bear no meaning and invite no response. We may even find eminent psychologists among these excluded sons; in which case their comments upon the book are more than likely to be superfluous. The goal of extroverted science has so far lain in the world of external and therefore verifiable phenomena. The goal of the introverted science of being is naturally incommensurable with that of its worldly and more successful twin. Yet science must embrace both. As Jung shows in the chapter on dream symbols of the process of individuation, the tendency towards psychical integration arises quite spontaneously at a certain phase of life and frequently becomes the major motive. In the next chapter he demonstrates the continuity of tradition through the history of alchemy, proving that the same symbolic material, which now appears within the individuation process, manifested itself in alchemy in the form of quasi-material projections. Since, therefore, individuation is a process of Nature which develops its own peculiar transformations within the individual psyche with a certain regularity, it follows that its study must eventually be incorporated within the body of science.

The chief obstacles in submitting the evidence to a general verdict are twofold. The first, exemplified to some extent in the present work, comes from the prolific nature of subjective material. The second, more serious still, comes from the fact that people who are outside the experience obstinately persist in regarding psychical material as unreal and imaginary. Thus a quandary is created; since those within the experience find the required elaboration of evidence superfluous, while those without will never even consider it. Actually, in the author's selection of relevant material in the very interesting dream-sequence of Chapter iv, insufficient evidence is provided to support some of the author's conclusions. Here and there one feels the need for more material and for a fuller knowledge of the subject's personal psychology in order to bridge the unavoidable gaps in the selected material; whereas in "The Idea of Redemption in Alchemy" the author gives a completely satisfying psychological explanation of that bewildering stream of tradition which carried the developing germ of individuation from antiquity to the Reformation.

In these two chapters Jung has begun to make the bridge between the individual process of healing within the modern soul and the central ideas of the alchemical quest. The present work is in the nature of a pontoon. It demonstrates that psychic continuity with the past can surely be established. But the great work which represents the actual construction of the bridge has yet to be done.

The translation from the German has been done with exceptional skill.

FUNDAMENTALS OF ELECTROCHEMISTRY

(1) The Principles of Electrochemistry

By Duncan A. MacInnes. Pp. 478. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

(2) Theoretical Electrochemistry

By N. A. McKenna. Pp. xiii + 470. (London: Macmillan and Co., Ltd., 1939.) 15*s*.

THE introduction of the activity concept by Lewis and his collaborators, and the development of the interionic attraction theory by Debye, Hückel, Onsager, and others, have stimulated interest in certain aspects of electrochemistry, particularly those dealing with conductance, transference numbers and electrode potentials. The researches in this field of physical chemistry have fallen mainly into two categories; these are, first, improvements in experimental technique for the purpose of providing more accurate data for testing the theories that have been proposed, and secondly, extensions of the theoretical treatment so as to include the behaviour of relatively concentrated solutions. The advances made in recent years have opened up new vistas in the study of strong electrolytes, and hence it is not surprising that, almost simultaneously, two books were published, one in England and the other in the United States, dealing with the fundamental principles of electrochemistry.

(1) In the preface of his book, Dr. MacInnes, who has made a number of significant contributions to our knowledge of transference numbers, conductance, cells with liquid junctions, etc., states that his object is "to furnish an account of theoretical electrochemistry as it is to-day". The first chapter is introductory and historical; then follow sections on Faraday's laws, electrolytic conductance and transference; the latter, as is to be expected, is particularly good. In the two succeeding chapters the essential thermodynamic principles are given clearly and concisely; it may be mentioned, however, that the symbols used by the author are not those in common use either in Great Britain or in the United States. The table on p. 104, in which the thermodynamic symbols employed in a number of familiar texts are compared, emphasizes the necessity for some form of standardization in this respect.

The next eleven divisions deal with various aspects of electrode potentials and their applications, the concept of activity and the Debye-Hückel theory and its extensions. The subject of electrolytic conductance is taken up again in the three following chapters, which deal with the Onsager theory and the use of conductance measurements in various fields of physicochemical investigation. In the last three chapters of the book the problems of dielectric constants and dipole moments, electrokinetic phenomena, and irreversible electrode behaviour are discussed briefly.

Although this book by Dr. MacInnes deals with the theoretical principles of electrochemistry, the outlook may be described as essentially practical. The experimental methods are explained fully, and the best available data are quoted to illustrate the principles and to test the various theories that have been proposed. The derivation of the important equations is given in detail; nevertheless, the reader does not get the impression that electrochemistry is almost entirely a theoretical subject. The author points out that electrochemistry is now so extensive that he has been compelled to make an arbitrary selection of topics, and he has very wisely chosen to treat in most detail those matters with which he has been actively concerned in his own researches. The space—13 pages—devoted to irreversible electrode phenomena, including passivity, is, however, liable to give a false impression to readers not familiar with this branch of electrochemistry; in some respects, therefore, it might have been better to omit this section entirely. The treatment of transference, conductance and E.M.F.'s is exceptionally good, and so far as these subjects are concerned the book constitutes a major contribution to the literature of physical chemistry. The text is remarkably free from misprints, and the whole work shows signs of exceptional care on the part of author, printer and publisher.

(2) The second book under review covers very much the same ground as that already considered; the author's guiding principle has been the Debye-Hückel theory, and once more the subject of irreversible electrode processes, the Cinderella of electrochemistry, is dismissed in a mere 17 pages. The outlook in the two books is, however, fundamentally different, for the one by Mr. McKenna gives the impression of being essentially theoretical in character. The main emphasis appears to be on the derivation of equations, and not so much on their experimental verification. It is true that there are descriptions of experimental methods, and that the book contains 109 figures, many of which constitute graphical representations of experimental results, but there are very few tabulations of data. The reviewer has sought in vain for tables of transference numbers, of ionic

and equivalent conductances, of activity coefficients, or of standard electrode potentials; these, at least, might be expected in a book on electrochemistry. Further, the erroneous use of "ln", where logarithms to the base 10 are intended, diminished the value of certain of the figures.

The derivations of the Debye-Hückel, Onsager, and other important equations, as well as the modified treatments of Gronwall and LaMer, of Bjerrum, and of Fuoss and Kraus, are given in more detail than is generally found in text-books, and many readers will be glad to have this material in an accessible form.

It is unfortunate, however, that what might have been a useful book is marred by a number of errors and inconsistencies. The following, among others, have been noted: p. 87, nitrobenzene is described as a proton donor; p. 88, the mobilities of the ions H_3O^+ and OH^- are said to be smaller than the mobilities of the corresponding ions in alcohols; p. 231, equation (347) is incorrect; p. 240, the interpretation of equation (363) is erroneous; p. 271, the antimony electrode is not "widely used as a substandard" in place of the standard calomel electrode; p. 309, the curves for different oxidation-reduction systems are not always parallel; p. 400, an aliphatic amino-acid is said to show "complete acid and base dissociation at the iso-electric point"; p. 417, the value recorded for the ionic product of water is far from being "one of the most accurate" available. There is much confusion of signs in the chapter on reversible cells, and the equations are not consistent with those derived in the section on thermodynamics.

A reader of sufficient experience not liable to be misled or confused will, however, find in this book much useful and interesting material concerning the theory of electrolytic solutions.

S. Glasstone.

KINETIC THEORY OF GASES

An Introduction to the Kinetic Theory of Gases

By Sir James Jeans. Pp. vi + 311. (Cambridge: At the University Press, 1940.) 15*s.* net.

In 1904 there appeared a slender volume entitled "The Dynamical Theory of Gases", in which the author, now Sir James Jeans, endeavoured to develop the theory "upon as exact a mathematical basis as possible". It was an original and somewhat severe book, the reader being at once confronted with the difficulties of the law of distribution of molecular velocities and with statistical mechanics and the controversies and unresolved problems on the equipartition of energy. At that time the English student whose reading was confined to his own language had to choose between the somewhat arid treatises by Burbury and by Watson, or the translation of Meyer's attractive, almost chatty, but unmathematical book. Jeans' book, which was much more akin to Boltzmann's elegant "Vorlesungen über Gastheorie", found acceptance, despite its severity, and many of to-day's physicists, as well as mathematicians, were 'brought up on it' so far as gas-theory was concerned, and looked to it as to an oracle, sometimes difficult to fathom as is the way with oracles.

In 1916, 1921 and 1925 new editions were issued. The difficulties concerning equipartition—Lord Kelvin's "Nineteenth Century Clouds over the Dynamical Theory of Heat"—had by then "to a great extent been dissipated by the development of the Quantum Theory, a theory explained in its proper place . . ." in the second and later editions. The account of the quantum theory, thus given, was among the first published in English, at a time when the theory was being developed almost wholly in other countries.

The subsequent enormous growth of the quantum theory led to the publication of many treatises upon it. These, together with the appearance of such works as R. H. Fowler's "Statistical Mechanics", decided Sir James Jeans to transform his "Dynamical Theory of Gases", on the exhaustion of the last edition, with the result now under review.

Among the first things the usually impecunious student may note about it is that the new "Introduction to the Kinetic Theory of Gases", though about three quarters the size of its predecessor, is only half the price—a welcome and almost miraculous reversal of the general trend in book prices, made possible, doubtless, by the wide circulation likely to be gained by any book by Sir James Jeans. The format is also smaller, less imposing and less forbidding, as befits a book intended less for the mathematician than for "the serious student of physics and physical chemistry".

The principal negative change in the book is the omission of all save a bare reference here and there to the quantum theory and wave mechanics, which do not appear even in the index; another omission is that of the brief chapter on aerostatics and planetary atmospheres, a subject the growth of which now demands a book (still wanting) to itself. Apart from these omissions, the major part of the "Dynamical Theory of Gases" is preserved in this book, often in the same words; but the order is changed, and several interesting interpolations are made, dealing with such subjects as Perrin's experiments on the Brownian motion, and the experimental verification of Maxwell's law of distribution of velocities by Dunoyer, Stern and Gerlach and others. Features in which the book is deficient, by comparison with other recent treatises (such as those by Loeb or Kennard), are the phenomena of gases at low densities, fluctuations, and the electric and magnetic properties of gases (the word mobility, for example, is not even in the index). It is for the author, however, to determine his own scope, and for the purchaser to decide whether or not he is suited by the result; there can be little doubt that, judged by the text, the book will deservedly succeed, and maintain for many years to come the already long association of the author's name with his present subject. S. Chapman.

ELECTRICAL EFFECTS AT CHEMICAL BOUNDARIES

Electrocapillary

The Chemistry and Physics of Electrodes and other Charged Surfaces. By Dr. J. A. V. Butler. Pp. x + 208. (London: Methuen and Co., Ltd., 1940). 12*s*. 6*d*. net.

MATTER being fundamentally electrical in nature, it is impossible to have two materials of different chemical composition which are not also different in electrical constitution. When different materials come in contact in such a way that electrical forces can produce observable effects, such effects are invariably present. They may arise through the materials being conductors, so that electric current may flow across the boundary, or through the boundary being deformable, so that electrokinetic effects, in the widest sense, may arise. Dr. Butler has neither written a long treatise on the whole vast subject, nor a brief general introduction to it, nor again has he chosen but one particular aspect. The selection of subjects has been made, as he explains in his preface, by avoiding those which he feels to have been adequately treated in other works, and by concentrating chiefly on those in which he has become, through his own researches, most interested. To the general reader, the book will therefore appear to lack balance though not interest. To a student interested in some particular point, it may prove to be informative, stimulating or wholly silent. The reviewer feels, therefore, that his chief task should be to summarize the subjects dealt with.

Although modern work on the response of nerve and muscle tissue to electrical stimuli has been left out of the scope of the book, it is Galvani's early observations on this subject which introduce us to the voltaic pile in the first chapter. This carries us quickly through ideas on the origin of electromotive force to the thermionic work function and quantum mechanics. A condensed chapter on thermodynamics follows, and then a fuller discussion of the mechanism of reversible potentials.

In the fourth chapter, a general discussion of electrical double layers, the distribution of ions in them, their capacity and experimental methods of studying them, is preceded and followed by a more specialized discussion of electro-capillary curves. The author accepts the letter of Guggenheim's contention that the single potential difference between two phases has no physical meaning, but appears to reject the spirit of it. Classical electrical theory can define potential differences exactly in terms of the work of transfer of abstract electric charges. The abstraction is justified only so long as a process begins and ends in matter of the same kind. In dealing with phase boundaries, we must be concerned frequently with inseparable electrical and chemical transfers: our exploring unit charge must be carried by an atom which is usually more affected by its chemical than by its electrical environment—or perhaps one should say by its micro- than by its macro-electrical environment. The reviewer feels this problem to be so fundamental to the whole subject that he could have wished it to be more explicitly dealt with. The diffuse part of the double layer, where this problem is of less importance, is dealt with again in the next chapter, which is concerned with electrokinetic phenomena in general. The author points out that the Faraday Society's discussion on this subject appeared too late for inclusion of reference to it in these chapters.

The remainder of the book deals with electrode reactions of various kinds. The lion's share of attention is claimed by the confusing subject of over-voltage, which the author has made remarkably intelligible. Deposition of metals and the formation of oxide films are discussed more briefly, and the book concludes with a short account of electrolytic oxidation and reduction.

G. S. Hartley.

ARCHÆOLOGICAL JOURNEYS IN WESTERN PERSIA

Old Routes of Western Īrān
Narrative of an Archæological Journey carried out and recorded by Sir Aurel Stein. Antiquities examined, described and illustrated with the assistance of Fred H. Andrews. Pp. xxviii + 432 + 97 plates. (London : Macmillan and Co., Ltd., 1940.) 42*s.* net.

UNTIL less than twenty years ago, excavation in Persia for archæological research was restricted by treaty for the French Government, and it is accordingly to the French Mission that we are chiefly indebted for our knowledge. The activities of that Mission have been confined to western Persia ; even when restrictions were removed and American expeditions undertook work, it was on sites in western or central Persia that interest centred. The consequence has been that, especially during the last ten years, a formidable *corpus* of material has accumulated and a large literature has served to place research at the service of field workers. In archæology, as in other scientific work, aims and methods are likely to vary in accordance with the stage of knowledge reached. In western Persia there is now no need for pioneer work, and no excuse for pioneer methods in digging or publication.

More than ten years ago, Sir Aurel Stein began travelling in eastern Persia, and since then he has covered the eastern and southern border-lands. There he was doing pioneer work. The archæological material he found, necessarily confusing owing to the circumstances of discovery, had considerable value because it showed the nature of the archæological material to be expected in hitherto untapped sources : it created problems, and showed where and how they might be solved. His last journey, however, was devoted to the west, ground by no means unexplored, but containing many unexplored sites. It is extremely doubtful whether any good purpose is served by soundings at these sites unless an expedition is fully equipped ; the report on soundings undertaken can only increase doubts on this matter.

The account of the actual journey is pleasantly written and strongly reminiscent of early nineteenth century travellers. But the book seems to be intended as a final record of "new finds of great antiquarian interest", in the manner of Sir Aurel's publications of his eastern journeys. Attention was given to four classes of antiquity, architectural remains, rock reliefs, a queer collection of statuary from one site, and pottery and small antiquities of early periods from many sites.

The architectural remains, mainly bridges, do not add to our knowledge more than the fact of their existence. The rock reliefs—why does Sir Aurel entertain such an affection in 1940 for *relievos* ?—are inadequately described, and the pictures are too small to be of use. This is most unfortunate. Good drawings, a minute description, full discussion of one set would have been infinitely preferable to the inadequate report on several here given. Tang-i-Sarawak especially deserves, and some day must receive, fitting publication which alone was now necessary as a record. There seem to be hints in the text that this monument may be Parthian, though there is no explicit statement ; this seems very unlikely, but is a matter of interest and importance. The traveller hurries on.

At the village of Shami the local people had just found some statuary in bronze, which will for many years constitute an archæological puzzle. Sir Aurel Stein, like M. Godard and M. Seyrig, who have both published scientific discussions, is convinced that a large statue of a man wearing typical trousers and a long moustache is Parthian. Of this there is not the slightest tangible proof. The dress is only similar ; it is not the same. The head does not point to such a date, even if it belongs to the statue (the set of the neck on the shoulders is very odd) ; it cannot be earlier than the establishment of Roman portrait types in the East, and is probably later than Palmyra and Gandhara. Fortunately, Sir Aurel was able to plan the remains of a building in which this statue and some other fragments were found. He calls it a shrine, chiefly because he identifies certain small structures as altars ; he then decides that a Hellenistic mask done in the style of the Alexander heads, a type constantly copied in the debased Hellenistic work of the East, "represented a royal personage, whether Alexander the Great whose worship prevailed for a considerable period throughout the Hellenized East, or also a Seleucid monarch. Its presence in the ruined shrine throws a significant light on the cult to which it was devoted". In fact, it is historically impossible to suppose that there was a cult of any Macedonian king at Shami when the large statue was made, and the mask may be earlier than the building, but cannot be much earlier. A careful examination at Shami should lead to a different conclusion.

But the greatest lack in the book is an adequate report on the soundings made and on the pottery found. Most, if not all, of the pottery belongs to perfectly well-known classes ; what is wanted is more information about the circumstances in which it was found. At Hasanlu, for example, there was a wonderful opportunity to investigate strata in which a highly distinctive form of pottery belonging to the early centuries of the first millennium occurs. The chance has been missed, and the publication of the pottery itself can only be called inadequate. Sir Aurel should have allotted more space to Mr. Andrews for technical descriptions, in the manner which can alone satisfy scientific requirements.

On the whole, then, this book from a veteran's hand will prove a disappointment to students; lovers of travellers' books will find it admirable. The publishers have made it a pleasant book to handle and read. Sidney Smith.

CELL "RADIATIONS"

The Secret of Life

Cosmic Rays and Radiations of Living Beings. By Georges Lakhovsky. Translated from the French by Mark Clement. Pp. viii + 201. (London: William Heinemann (Medical Books), Ltd., 1939.) 10*s*. 6*d*. net.

GEORGES LAKHOVSKY is an engineer who, struck by the idea that radiation might be concerned in the peculiar phenomena of life, formulated a hypothesis and has collected evidence in support of his views. Reduced to its simplest terms his theory is that the cell, as the unit of life, is an electromagnetic resonator, capable of emitting and absorbing radiations of very high frequency, that life is the harmony of multiple radiations of all the cells in a body reacting upon one another, and that disease is a disequilibrium introduced from outside into the cell-harmony.

There is evidence that certain creatures are susceptible to vibrations beyond human sensitivity, and even that some may emit such vibrations; but the author's knowledge of animal life is so limited that improbable examples are mixed indiscriminately with probable. For example, he suggests that lemmings occasionally require fishes for food, and on that assumption he explains the migrations of lemmings, which may reach the sea, as being the response to radiations from shoals of marine fishes (p. 36). Response is due to auto-electrification produced by an animal when it waves its tail in the air; the lemmings would have difficulty in performing that feat. The zoological standard is suggested by "amongst nocturnal birds let us take the bat as an example" (p. 35), or by the inaccurate statement that terns (called sterns) perform a series of circular movements in the air before alighting to fish in the waves (p. 46), though the translator is responsible for the "alighting", which is not expressed in the original text.

The theory, however, is based upon the structure of the cell and by that must be tested. The nucleus is said to be the seat of radiation. This is due to the chromosomes or nuclear filament, described as tubular, composed of a core of organic materials or mineral conductors surrounded by an insulating membrane of cholesterol, plastin and other dielectric substances; so that the twisted coil constitutes an electric circuit endowed by construction with self-inductance and capacity, which may be compared to an oscillating circuit. The description is so far removed from known facts, and the illustrations of chromosomes which accompany it are so crude, that even in this matter, all-important from the point of view of the hypothesis, the knowledge of the author becomes suspect; and the suspicion is confirmed almost on the next page where a description and a figure said to be of *Corynactis viridis*, a "marine organism measuring but 0·1 mm.", is no more than part of a stinging cell of that sea-anemone, and the "oscillating circuits" are the thread of the cnidocyst, the primary purpose of which has certainly nothing to do with emitting radiations.

It may be that cells emit and receive radiations, but the hypothesis is not substantiated by these tenuous speculations. Since the basis of the theory fails, it seems unnecessary to examine the other claims of its author. His multiple wave oscillator, to which a special appendix is given, may work and apparently has worked marvellous cures in cases of cancer, goitre and enlarged prostate, but that does not prove that its electric radiations acted upon hypothetical cell-oscillations; nor is his statement that fever causes the death of cells by "melting" the insulating membrane of nuclear filaments likely to be taken seriously.

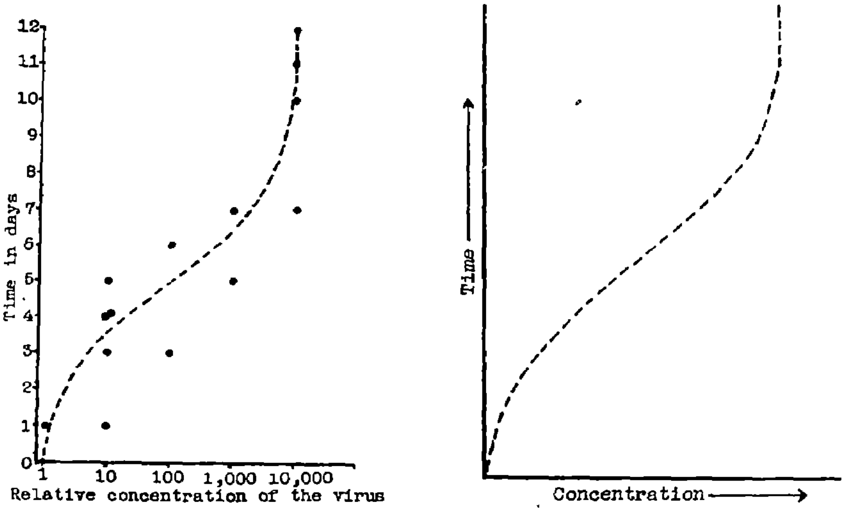
We have discussed the weaknesses of this revelation of the secret of life at more length than may seem necessary, because the author and his translator consider that biologists and particularly British biologists have neglected the theory. The translator suggests that the backing of Prof. d'Arsonval indicates exceptional merits in the work; but it is only fair to say that d'Arsonval's preface is frankly non-committal.

James Ritchie.

VIRUS AND VITAL ORGANIZATION

By Dr. John Grainger,
Tolson Memorial Museum, Huddersfield

Research workers who deal with virus diseases have many brilliant pieces of investigation to their credit. The study of little more than a decade has elucidated the size of different virus particles, the nature of virus protein, and its reactions as an immunological agent; the patient inquiry into virus pathology has now made possible a general review of the problem. A recent book[1] by Dr. Kenneth M. Smith, one of the foremost authorities on the subject, still says, however, that it cannot yet be said whether the virus is living or not, and many modern reviews of the problem[2,3,4] testify to the intense, though still unsatisfied, interest in this particular question. It is, indeed, of fundamental importance to determine whether virus is the smallest living entity or the most complex of non-living phenomena; it is already conceded by most research workers that it occupies a position intermediate between these states, having affinities with both.



(*a*) (*b*)

Fig. 1.

(*a*) Rate of increase of Nicotiana virus 1 in tissue of *Nicotiana tabacum*.
(*b*) Rate of increase of the autocatalyst in an autocatalytic reaction.
The *S*-curve is also characteristic of the rate of increase of bacteria, and of other growth-rates.

The chief difficulty is to define the qualities which separate living from non-living matter. The older biological dicta that reproduction, irritability and movement are the main criteria are no longer tenable without qualification. Reproduction, as exhibited in bacteria, the lowest form of life accepted at present, has a direct parallel with the rate of increase of one product in a non-living, autocatalytic reaction (Fig. 1). One has, indeed, merely to transpose chemical and bacteriological nomenclature to see the complete similarity. The bacteriologist says a bacterium acts upon a culture medium to produce more bacteria; the chemist states that an autocatalyst acts upon another substance to produce more of the autocatalyst. Reproduction in its simplest form, therefore, is not a reliable character for the separation of living from non-living. Irritability, if conceived as a reaction to external stimulus, is of even less value, since inanimate objects respond implicitly to outside forces such as temperature, magnetism, contact, light, and other factors of the environment.

Movement may also be a response to external stimulus such as gravity, but autonomous movement, or motion controlled by the organism itself, gives the first real clue to the quality of life. Living things are not completely at the mercy of their environment, whereas non-living matter has a totalitarian subjection to external surroundings. Thus a non-living mass of protein always rolls down a slope with unquestioning obedience to the law of gravity; living protein in certain forms *can* move up the slope, following its internal direction. It does not always do so; gravity is often the dictator, but the living organism is not completely subject to the laws of gravity. Motile bacteria can move against a slight stream of liquid; inanimate particles are always carried with the flow, or left stationary. The organization of evolution can, I think, be conceived as having three departments: the non-living, which is completely dependent upon its surroundings, the living, where independence of the environment exists in varying

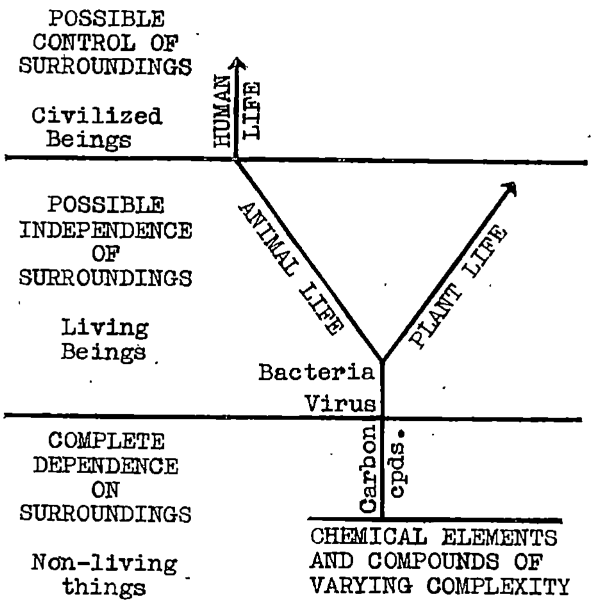

POSSIBLE CONTROL OF SURROUNDINGS
Civilized Beings
HUMAN LIFE
POSSIBLE INDEPENDENCE OF SURROUNDINGS
Living Beings
ANIMAL LIFE
PLANT LIFE
Bacteria
Virus
COMPLETE DEPENDENCE ON SURROUNDINGS
Non-living things
Carbon cpds.
CHEMICAL ELEMENTS AND COMPOUNDS OF VARYING COMPLEXITY

Fig. 2.

Diagram to show the relations of civilized and living beings with non-living things.

degree, and civilized humanity, where some measure of control of external events and conditions is possible (Fig. 2).

The virus multiplies within its host, and also moves therein. Is this motion subject to the host, or does it exhibit any degree of autonomy? Results from such an inquiry ought to show whether the virus possesses any claim to vital organization. A plant host is particularly suitable for such studies, since it eliminates the gross circulation of a bloodstream and provides gentle barriers, more amenable to investigation.

It is a well-known fact that a tobacco plant can be infected by inoculating Nicotiana virus I into the epidermal cells of the stem. The virus can later be recovered from all parts of the plant, thus involving a transfer across the relatively inert cells of the cortex, where protoplasmic streaming could not provide an aid to progress, and where the static conditions of osmosis or of salt concentration within the cells are probably the dominant forces. The rate of travel is too great for an explanation in terms of diffusion[5,6]. Here, then, is *prima facie* evidence that virus movement is not necessarily dependent upon the streams of nutrient, water or protoplasm which are known to be present in the green host plant.

It has also been shown[6] that virus can multiply within a tobacco leaf severed from the plant and kept in a humid atmosphere. Here the various streams of transpiration and translocation within the plant are eliminated, yet the virus advances in a wave down the leaf, following inoculation at the tip. It may even move faster than in a similar leaf attached to the plant, and can be detected in the lamina of the leaf before it occurs in the midrib, thus demonstrating the elimination of mechanical transport along the conducting tissues. It is noteworthy that tobacco leaves scratched with a sterile needle at the tips, as for inoculation, and then dipped in red ink solution, did not permit any transfer of the inanimate dye. Similar results can be obtained with detached stems; the virus spreads upwards and downwards at about the same rate (Fig. 3), and appears to be independent of any help from the host. It does not seem to make any difference if a bias is given to the transpiration stream by leaving one or two leaves upon the detached stem[6]. In so far as the passage of a dye can be regarded as an indication of the transpiration stream, it very often follows a course different from the virus. Red ink taken up from the cut end of a shoot penetrates the vascular ring of the stem and enters the lower leaves first; the virus often proceeds first to the youngest leaves. Transport to the growing point by the stream of elaborated nutrients in this case appears to be ruled out by the fact that virus spreads downwards in the stem at about the same rate as it moves upwards[6]. Carriage of the virus by protoplasmic streaming would require a linear rate of movement; Fig. 3 shows that the virus has a logarithmic rate of travel, which could, moreover, be given by a population increasing in geometric progression and free to orientate themselves into the first new tissue they reach within the parallel confines of a stem. The similar rates of upward and downward movement again eliminate the possibility that protoplasmic streaming might carry the virus predominantly in one direction.

In the matter of temperature also, virus is not completely dependent upon its host. It does not

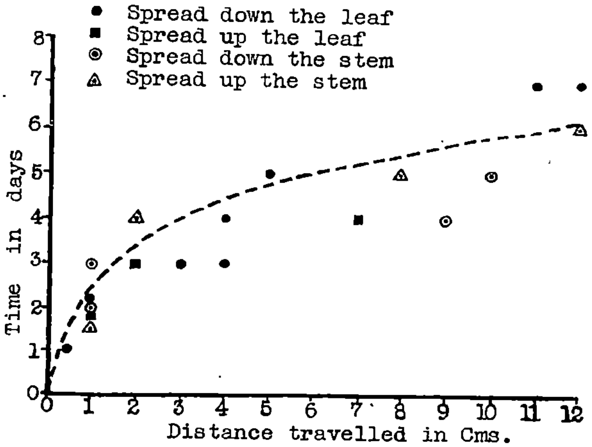


Fig. 3.

The rate and manner of spread of Nicotiana virus I in leaf and stem tissue of *Nicotiana tabacum*, following a limited inoculation.

produce symptoms at all temperatures at which the host will grow, though virus is present in the tissues[7,8,9]. The virus, moreover, has a temperature of optimum activity different from that of its host[7,8], thereby exhibiting a degree of independence of the plant which it attacks.

It now seems possible to suggest that the virus is actually a living organism, since it exhibits a type of independent movement through its host which can only be interpreted as autonomous, and shows further independence in the calibre of its temperature relations. It is not yet possible to envisage the actual mechanism of the movement. Sheffield[10] has produced categorical evidence that protoplasmic connexions between cells are necessary. The experimental evidence, however, seems to indicate the broad fact of virus autonomy.

The results of many workers, notably Stanley and Bawden and Pirie, show that the virus is a crystalline protein, different from the usual biological conception of such substances. This has been interpreted as an argument against the living nature of the virus, but cannot, I think, be an overwhelming criterion. Difference in structure between the protein of fungi and bacteria must have seemed great at the time of its discovery—as large as the known differences between bacterial and virus protein. Moreover, virus is not always crystalline; it may occur as amorphous inclusion bodies, which look much more like the traditional proteins of biology. The lack of demonstration of virus respiration is not a significant difficulty, for it is impossible to separate bacterial respiration from changes of the substrate brought about by the organism; both bacteria and virus disturb the composition of the substrate. Virus is active within the limits of temperature already known for other organisms, and its inactivation by chemicals presents no feature not already familiar to the biologist.

One corollary from the living nature of the virus is somewhat difficult of elucidation; if virus was the first form of life, it ought to be possible to find prototrophic viruses which feed on inorganic materials. Those known at present are entirely parasitic, but the detection of prototrophic viruses presents so many difficulties that they are not likely to be discovered until research comes to be organized with an intensity comparable to the present war effort.

[1] Smith, K. M., "The Virus; Life's Enemy" (Cambridge: Univ. Press, 1940.)

[2] Davis, L. J., *Proc. Rhodesia Sci. Assoc.*, **37** (1939).

[3] Levaditi, C., *Bull. Soc. d'Encour. pour l'Indus. nationale*, 137^e^ annee, 27–42 (1938).

[4] Rivers, T. M., Lecture to N.Y. Acad. of Med., March 29, 1940. See also NATURE, **145**, 853 (1940).

[5] Grainger, J., *Ann. Appl. Biol.*, **20**, 2, 236–257 (1933).

[6] Henderson Smith, J., *Biol Rev.*, **5**, 2, 159–170 (1930).

[7] Grainger, J., NATURE, **137**, 31 (1936).

[8] Grainger, J., *Phytopath.*, **29**, 5, 441–448 (1939).

[9] Johnson, J., *Phytopath.*, **11**, 446 (1921).

[10] Sheffield, F. M. L., *Ann. Appl. Biol.*, **23**, 3, 506–508 (1936).

THE AIR-DRIVEN ULTRACENTRIFUGE

By Dr. F. R. Eirich and Prof. E. K. Rideal, M.B.E., F.R.S.,

Laboratory of Colloid Science, Cambridge

SEDIMENTATION and diffusion constants of macromolecules are conveniently determined with the oil-driven ultracentrifuge of the Svedberg type. Such machines are not generally available for normal routine laboratory work, and in a search for an apparatus which was at the same time simple to run, economic to install but also precise in operation, our attention naturally turned to the air-driven top of Henriot and Huguenard, which has been developed so well in the United States by Beams, McBain and especially by the Sharples Centrifuge Company of Philadelphia.

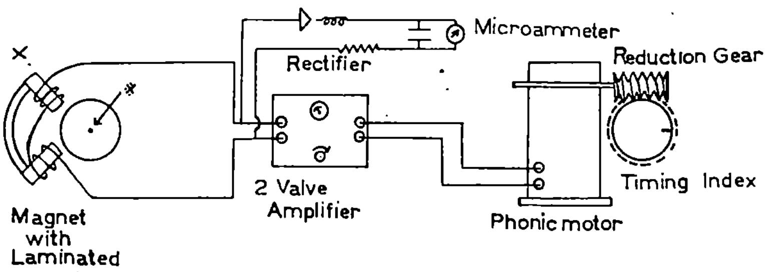
Whilst machines of this type have frequently been used for purposes of separation and determination of approximate mass weights, it seemed worth while to examine how far it could be made an instrument of precision.

After a visit to Philadelphia, an experimental model was kindly constructed for us by the Sharples Co. The driving mechanism is of the turret-type[1], and spins a round rotor (8·85 cm. diameter) in an atmosphere of hydrogen. The air pressure necessary to lift the rotor is 5¼ lb./sq. in., and 20 lb./sq. in. air pressure on the driving jets produces a speed of about 75,000 r.p.m. at 15 mm. hydrogen pressure. The bursting risk limits the speed to 105,000 r.p.m. (fields of 372,000 *g* in the cell), but in the interests of safety speeds exceeding 85,000 r.p.m. (245,000 *g*) are rarely used, allowing molecular weights of about 15,000 (cytochrome *C*) to be determined.

The solutions to be examined are contained in transparent cells differing but little from those used by Svedberg[2]. The cells are sectorial in shape, 10 mm. high, 2 mm. deep with a radial angle of 5°; the depth, which influences the working concentrations, has since been increased to 5 mm., and recently a modification of the original design has enabled cells 10 mm. deep to be used. The weights of these cells are adjusted to 0·001 gm. and the position of the centre of gravity (height above bottom plate) to 0·1 cm., thus reducing the stresses in the rotor.

The speed of the rotor is measured by amplifying an alternating current to drive a synchronous motor. The current is generated by a small brass disk, containing an iron segment, which is fixed to the top of the rotor shaft and rotates in a magnetic field. The general scheme is as illustrated (Fig. 1).

It has been stated that this or a similar method of speed measurement has been applied in the Laboratory of Physical Chemistry, Uppsala, and was criticized[3] for not functioning reliably at speeds above 90,000 r.p.m. Our own experience is that it is entirely satisfactory and preferable to all stroboscopic methods. The highest operating speed used on this ultracentrifuge has been 91,700 r.p.m., and the speed indicated was checked by plotting the driving air pressure at lower speeds and extrapolating to 91,700; no large error was observed. The inaccuracy can be made of the order 0·1 per cent with practice as it only entails stop-watching a mark past an index. The reduction gear is such that each revolution of the mark per minute corresponds to 10,000 r.p.m. of the rotor. A rough evaluation of the speed is obtained from the current output of the generator.



X Generator givinq one pulse per Revolution

* Spindle of Centrifuge attached to brass disc with iron segment

Fig. 1.

Revolution counter: schematic diagram

After preliminary examination of several methods of optical examination, including that of Lamm, we finally decided to make observation of the sedimenting boundary by the Philpot *Schlieren* method[4]. The optical bench, some 2·8 m. long, was erected on concrete pillars and isolated from the rest of the basement floor. The centrifuge, likewise mounted on a concrete table, ran perfectly smoothly without any vibration, even when the air compressor (Ingersoll-Rand) was in operation. The diagrams first obtained (2 per cent solutions in the cell) were good, but when the resolving power was increased by magnification (0·1 per cent solutions in the cell), the diagrams were crossed by innumerable dark lines which hazed the outline of the sedimenting 'peak'. These lines were eventually traced to refractive index gradients in the material of the lenses and plates. The two fused quartz plates which admit the light beam into the centrifuge housing were found to be particularly bad, so these were removed and replaced by the two *Schlieren* lenses. Many of the dark lines were due to dust particles on the lenses and edges, so these are now kept clean. The lamp used is a Philips tungsten ribbon lamp (100 w. 6 v.) and the intensity is such that exposures are only one tenth as long as those required with the mercury lamp previously used.

At the present time there is some uncertainty as to the temperature of the rotor; the rotor spins in hydrogen at *ca.* 10 mm. pressure in a chamber through the walls of which is circulated thermostated water. It was assumed in the preliminary runs that the rotor is at the temperature of the walls; this, however, is probably not the case and a method for determining the exact temperature is being evolved.

Up to the present time, only sedimentation velocity measurements have been made, but it is hoped before long to include sedimentation equilibrium determinations. In addition to the sedimentation constant the diffusion constant of the solute must be known. A value for the diffusion constant can be obtained[5] from the sedimentation by applying Weiner's[6] development of Fick's law.

The experimental results described below were carried out more with the idea of developing technique than measuring molecular weights, but the results are sufficiently interesting to warrant description. When considering these results, it should be remembered that the sedimentation constant S_{20} is calculated assuming that the temperature in the cell is the same as the walls of the chamber. The materials centrifuged were several proteins.

Ovalbumin. A sample of ovalbumin was subjected to analysis to determine whether the instrument was functioning satisfactorily; the results are given in Table 1, together with data[7] obtained

Table 1. Ovalbumin.

Solution, 0·75 per cent ovalbumin in 0·2 *M* sodium chloride. $T = 25°$ C. *p*H 8·0.

	Air driven	Oil driven (Uppsala)
Sedimentation constant, S_{20}	$3 \cdot 75 \times 10^{-13}$ cm./sec.	$3 \cdot 55 \times 10^{-13}$ cm./sec.
Diffusion constant, D_{20}	$7 \cdot 6 \times 10^{-7}$ cm./sec.	$7 \cdot 76 \times 10^{-7}$ cm./sec.
Molecular weight	49,000	43,800

(*Continued on page 551.*)

NATURE

SUPPLEMENT

Vol: 146 SATURDAY, OCTOBER 26, 1940 No. 3704

SHORT REVIEWS

Vital Religion

A Brotherhood of Faith. By Sir Francis Younghusband. Pp. ix+101. (London: John Murray, 1940.) 3*s*. 6*d*. net.

SIR FRANCIS YOUNGHUSBAND relates that, at the end of his successful mission to Tibet thirty-four years ago, to negotiate a treaty of commerce and intercourse, he went alone to the mountainside with the feeling of peace on earth and goodwill among men filling his mind and heart. It was there and then that he became exalted with emotion like that experienced in evangelical conversions, and to which modern psychology is inclined to refer all religious convictions. From that time he has in several books, and in the organization of World Congresses of Faiths, been delivering the message of fellowship among men of all high religious beliefs.

In this small book Sir Francis brings together eight addresses given by him on this theme. The spiritual and ethical elements in the great religions of the world should unite people of many countries in the common cause of truth and righteousness. A World Commonwealth may be a dream, but the federation of faiths is one way of approaching it, and the movement of which Sir Francis is an inspired apostle is towards that high destiny of mankind.

The Soul of the Universe

By Gustaf Strömberg. Pp. xviii+244. (Philadelphia: David McKay Company, 1940.) 2 dollars.

THIS book contains a clear and well-written statement of some recent developments in physical and biological theory. Combined with this is a speculative cosmology based on the hypothesis of a world-soul. This is worked out in some detail with considerable ingenuity, specially in its biological and psychological implications. Unfortunately the working out requires subsidiary *ad hoc* hypotheses of the kind that enable any theory to be fitted to any facts. It must be said in favour of the author that his account is plain and straightforward and free of the mystifications and paradoxes used by certain contemporary popularizers. The book may appeal to the general public on its merits. It is scarcely likely to interest the man of science, and the philosopher who is concerned with the notion of the world-soul will probably prefer Plato's "Timæus", even though the physical theory is out of date.

Chemicals of Commerce

By Dr. Foster Dee Snell and Dr. Cornelia T. Snell. Pp. viii+542. (London: Chapman and Hall, Ltd., 1940.) 28*s*. net.

AS chemicals enter more and more into commerce there arises the need among those who have to deal with them for a minimum of information giving at least the salient facts. Chemical dictionaries tend to become too long and are expected to be more or less complete to be of service. The authors have made a selection of substances of trade importance and give more or less information about them in paragraphs grouped into chapters under appropriate headings. The chemical composition, but not the structural formulæ, of the substances is indicated. For each product there is in general given a short description, method of manufacture, common impurities, commercial grades and uses.

The book is primarily intended for American consumption, where they are more chemically minded than in Great Britain; by people without formal chemical training. The wide experience of the authors as consultants makes it probable that the selection is sound and the information reliable; the venture deserves success as a means of spreading accurate chemical knowledge.

Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests. Pp. iv+149. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s*. net.

THIS second volume of the treatise on electrochemistry and electrochemical analysis deals with gravimetric electrolytic analysis, including internal electrolytic analysis (in which the electrolysing current is generated in the deposition cell itself by anodes of baser metal separated from the test solution by a diaphragm), electrolytic micro-analytical methods and the electrolytic Marsh test as applied to arsenic, antimony and germanium. Particular attention is given to methods of separation by control of the cathodic potential with the aid of an auxiliary electrode. The treatment is essentially practical, the first chapter dealing fully with apparatus, the second with technique and the remaining six chapters with special determinations and separations. Industrial applications, such as alloy analysis, are adequately covered.

Since many of the methods have been developed or perfected by the author, the treatment is based on sound practical experience, and the many small details which are essential for success are satisfactorily presented. The compositions of the solutions, for example, are given, together with the electrolysing currents and voltages and the method of treatment of the deposit for weighing if this is necessary.

The book is a valuable contribution to the literature of analytical chemistry and should find a place in every laboratory. A third volume dealing with volumetric methods, capacitance measurements and *p*H determination is planned.

Elementary Crystallography

By Dr. John W. Evans and George M. Davies. Second edition. Pp. vii+149. (London: Thomas Murby and Co., 1940.) 6*s*. 6*d*. net.

THIS well-established text-book has served some generations of students faithfully and continuously. It now re-appears in its traditional form, but with the addition of a particularly clear account of X-ray crystallography, accompanied by illustrations from the work of Mrs. G. M. Davies.

This new section follows the usual lines: the important point is that readers of this second edition will have before them an adequate introduction to modern methods, alongside the classical treatment.

Aids to Physical Chemistry

By R. G. Austin. Pp. x+361. (London: Baillière, Tindall and Cox, 1940.) 5*s*.

THIS little manual is a valuable member of the "Students' Aid Series". All the usual branches of physical chemistry are represented, and the information is at once concise and adequate. Perhaps it is well to stress that the booklet is not intended to be a substitute for text-books; to use it for such a purpose would be a great mistake. Its purpose is to facilitate reference by those already conversant with the subject. There are many numerical examples, worked out in full.

Hydrocarbon Chemistry

A General Discussion held by the Faraday Society, April 1939. Pp. ii+805–1092. (London and Edinburgh: Gurney and Jackson, 1939.) 12*s*. 6*d*. net.

THIS volume comprises the papers presented at one of the Faraday Society's well-known discussions, that on hydrocarbons held in London a few months before the outbreak of war. It fully maintains the standard expected of those deliberations. Part 1 deals with homogeneous thermal reactions, Part 2 with catalysis, Part 3 with synthesis and transformations, and Part 4 with olefine polymerization. The introduction is contributed by Prof. E. K. Rideal.

The subject is of great importance to-day, in view of increased piston speeds in many engineering problems, and the insatiable demand for higher pressures in bearings. Again, new chemical industries are likely to look upon hydrocarbons more and more as a source of raw materials.

Some theoretical work of great interest upon structural and energy problems is presented by Lennard-Jones and Coulson, and a critical review of the pair theory of mesomerism by Lloyd and Penney. Hydrogenation of coal and lignite is discussed as a large-scale example in Part 3. As usual, much detail is brought out by individual speakers on their special aspects of the general theme.

Colloid Chemistry (A Textbook)

By Prof. Harold Boyer Weiser. Pp. viii+428. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s*. net.

THIS text-book, by the author of the well-known "Inorganic Colloid Chemistry" in three volumes, is intended for students who have an elementary knowledge of physical chemistry, and is planned to acquaint the student with the foundations of colloid chemistry, to formulate systematically and to correlate critically the theories underlying colloid chemical behaviour, and to illustrate the wide applications of the subject in the fields of the industrial arts, agriculture and biology. After a brief introduction on general principles, there are seven chapters on adsorption at various types of surfaces, ten chapters on the preparation and properties of lyophobic and lyophilic sols, two shorter sections on gels, emulsions and foams and aerosols and solid sols, respectively, and finally two chapters on the applications of colloid chemistry to contact catalysis, dyeing and clay. Numerous useful references are given, many of them to technical as well as scientific journals.

The treatment is on the whole descriptive and experimental rather than theoretical and mathematical, although many important equations are deduced and the section on Brownian movement gives a simplified derivation of the Einstein equation. There are many tables of numerical data, and the quantitative side of the subject is well cared for. Historical developments add interest to many sections, and the older classical work of Graham, Linder and Picton, Freundlich, Ostwald, and others receives proper recognition alongside the newer developments of the subject. In this way a well-balanced treatment is achieved, and the misleading idea that the subject is of very recent growth is corrected. A critical treatment of the results and theories (for example, of the so-called activated adsorption) is a valuable feature. Modern work is well represented, and a concise yet clear style has made it possible to give a very large amount of interesting information in a small compass.

The reader never feels that the treatment is sketchy, and the student who assimilates the contents of the bbok will have laid a solid foundation for further study of special fields of colloid chemistry. There are more than a hundred good illustrations.

Chemical Calculations

By J. S. Long and H. V. Anderson. (International Chemical Series.) Fourth edition. Pp. xii+266. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 11*s.* 6*d.*

THE fact that this book has reached a fourth edition in six years indicates that it has achieved popularity, and the contents show that it provides a very sound and interesting course of exercises. Each section has an introductory outline and a brief statement of the underlying theory, and much of the material here presented is supplementary to that found in text-books. The examples for exercise are numerous, well-chosen and in very many cases provided with answers. Although it is stated that answers are "purposely omitted" in come collections of problems, it is not clear that this has any advantage, and these might well be provided in future editions.

The usual topics in an elementary course are well covered and special mention must be made of the chapters on gas analysis, oxidation and reduction, and those parts of physical chemistry which are of importance in chemical analysis (mass action and solubility product). In the sections on ionic equilibrium the limitations to weak electrolytes are not emphasized, and in calculations involving strong electrolytes the fact that complete ionization is assumed and that the simple law of mass action should not be applied to them is not clearly stated. There is no reason why this should not be done even in an elementary course, and these chapters might well be supplemented and revised in future editions.

The intention of the authors to fit the student to encounter the actualities of chemistry is wholly praiseworthy, and it has been very ably implemented in the book. As they say: "chemical calculations serve to develop in the student aptitude in the application of various principles of chemistry under actual working conditions", and since the book can be covered in fifteen weekly periods in the first year, this valuable training should not encroach unduly on other parts of the course.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 27: Magnesium. Teil B, Lief 4: Schluss der Verbingungen, Technische Darstellung der Magnesiumverbindungen. Pp. 423–550+xx+xviii. (Berlin: Verlag Chemie, G.m.b.H., 1939.) 18.75 gold marks.

THE present part of "Gmelins Handbuch" covers compounds of magnesium with the alkali metals and ammonium and beryllium, and describes technical methods of manufacturing the oxide, hydroxide, carbonate, chloride and sulphate of the metal. Magnesium oxide and hydroxide are manufactured chiefly from magnesite, although numerous processes have been adopted for utilizing dolomite. The temperature at which the oxide sinters is very high, but can be lowered appreciably by the addition of ferric oxide. The hot material is sprinkled with water to hydrate any calcined limestone, dolomite or caustic magnesia, which react much more easily than sintered magnesia to form a dust which is easily separated.

Much work has been done on the preparation of anhydrous magnesium chloride for the electrolytic extraction of the metal. As is well known, dehydration of the hexahydrate is accompanied by hydrolysis, so that the salt has to be heated in the presence of hydrogen chloride, which causes rapid corrosion of the vessels from 325° C. upwards, but it has been found possible to raise the temperature to 450° C. and thereby greatly accelerate dehydration by rigorously excluding air. Other methods used for dehydration of the chloride involve either electrolytic decomposition of the water alone, or the formation at low temperatures of a hexamine which can be dried at 300° C., or the conversion of the oxide direct to chloride.

Introduction to Carbohydrate Biochemistry

By Dr. D. J. Bell. Pp. viii+112. (London: University Tutorial Press, Ltd., 1940.) 3*s.* 6*d.*

NO class of organic compounds surpasses the carbohydrates in interest. Sir Frederick Hopkins speaks of the intellectual thrills induced by the progress of the work of Emil Fischer in particular: since then the development has been to some extent in Great Britain. Almost every worker in biochemistry, using the term in its widest significance, has to know something about the sugars and to master their structural formulæ. It is for these that the present book is provided, and its ordered assembly of formulæ drawn and printed with praiseworthy clarity will go far to make what is in reality difficult appear easy.

The subject-matter is highly concentrated, but the author has the knack of putting the essentials into the fewest words. After describing the sugars themselves he discusses the liberation of energy during fermentation, metabolism in muscle, uronic acids, glycosides, nucleotides in particular. Sufficient references are given to the literature.

The book forms a notable contribution to any library which no biochemist can be without.

Principles of Animal Biology

By Prof. Lancelot Hogben. Second edition, revised. Pp. 415. (London: George Allen and Unwin, Ltd., 1940.) 7*s.* 6*d.* net.

PROF. HOGBEN'S text-book on animal biology was first published in 1930 and later went out of print. The present edition planned on the same lines as the original, although the pattern has been improved by the adequate revision of the whole book and the complete rewriting of certain chapters. This applies particularly to the chapter on fossil veterbrate skeletons, which has been extended and remoulded in order to include references to the many new discoveries of the past ten years. An advantageous innovation in this edition is that the combination of author Hogben with artist Horrabin, which was so successful in the preparation of "Science for the Citizen" and "Mathematics for the Million", has again been used. Mr. Horrabin has redrawn each illustration and has added many new ones, in which diagrammatic clarity is constantly emphasized, although never at the expense of artistic refinement.

Prof. Hogben remarks in the preface that this work is not intended to supplant dissecting manuals or formal text-books ; it has been prepared solely as a supplementary reader to the more rigid lecture courses in animal biology taken by candidates of Higher Schools and first-year university standard, emphasis throughout being placed on function rather than on structure. *Homo sapiens* receives attention strictly on his merits as a vertebrate animal, although one might have hoped that the author had dipped his pen in a less restraining fluid. A general criticism of the book is that Prof. Hogben frequently overestimates the sum total of factual information possessed by university students after a one-year course in zoology. This is particularly evident in the chapter dealing with the principle of succession with special reference to the vertebrate skeleton. The new edition is a useful addition to the current stock of literature, however, and should establish itself as quickly and successfully as its predecessor. As one would expect in a second edition, the book is free from even minor inaccuracies.

Silviculture of the Trees of Trinidad and Tobago, British West Indies

By R. C. Marshall. Pp. xlvii+248+16 plates. (London : Oxford University Press, 1939.) 21*s*. net.

IN this book the author summarizes, from a sylvicultural point of view, the results of eleven years work, during which he was in charge of the Forest Department of Trinidad and Tobago. The first part of the book consists of an account of the physiography and vegetation of the two islands, condensed from the author's previous publication (*Oxford Forestry Memoirs*, No. 17 ; 1934).

In a brief discussion of the sylviculture of the tropical high forest which follows, the author urges the advisability of so conducting regeneration operations as to produce a forest resembling the natural type, especially in structure, though with a higher proportion of valuable species. In these forests the number of such valuable species is small ; they are found usually in the dominant class and there is a tendency to confine attention to them. The importance of the sub-dominant and understory constituents for the maintenance of the health and well-being of the forest must be recognized though it is not fully understood. "The question at issue is to what extent the very complex natural vegetation can be simplified without impairing the properties that enable it to persist healthily as a vegetative type, self-supporting and permanent."

The bulk of the book consists of descriptions of the trees of the islands, arranged in families as in a Flora, under some or all of the following heads : name, botanical and vernacular, general description of the tree, distribution and habitat, botanical, germination, seedling, sylvicultural characteristics, regeneration, utilization. The botanical descriptions are nearly all from field examinations of fresh material. Twenty-eight excellent line drawings by Mrs. Marshall supplement the botanical descriptions of the more important species.

Laboratory Studies in Zoology

By Dr. H. D. Reed and Prof. B. P. Young. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xii+207. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 9*s*.

THIS is the second edition of the manual used by beginners in zoology at Cornell University. The frog is dissected in some detail to illustrate bodily structure in a vertebrate, followed by a study of the usual invertebrate types, Amphioxus and a freshwater fish. The only mammalian material is the eye, though it is suggested that at the end of the course an opportunity should be given for an investigation of the fœtal pig. The simple tissues are dealt with very briefly. Practical studies in mitosis, gametogenesis and heredity are a welcome addition to the first-year course, and are rarely attempted in Great Britain. In embryology the student sees the early developmental stages of the starfish and all the stages in the life-history of the frog. A study of mixed protozoan cultures provides training also in the use of a key for the identification of common species.

Directions and descriptions are clearly expressed, and questions at the end of each chapter suggest problems for the student to elucidate for himself. The production of the book is excellent.

Anatomy of the Sheep's Brain

A Laboratory Atlas for Students of Zoology. By Prof. E. A. Briggs. Pp. xiii+50+8 plates. (Sydney : Angus and Robertson, Ltd., 1939.) 6*s*.

THIS small book contains a useful elementary account of the structure of the sheep's brain intended, as its sub-title suggests, for first-year students of zoology. The brain of the sheep from its size and the ease with which it can be obtained and handled affords a much better object for study than the brains of the smaller mammals generally employed for dissection in this course. The detail given is well-suited for first-year zoology, but the medical student would also find it helpful to work through it as a revision exercise before passing on to the detailed study of the more complex human brain. The text is written in a clear and straightforward manner, and the well-produced illustrations add considerably to its usefulness.

Notter and Firth's Hygiene

Revised by L. C. Adam and E. J. Boome. Tenth edition. Pp. x+518+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 12*s*. 6*d*. net.

SINCE the last edition of this well-known work which appeared in 1921, so much advance has been made in the domain of hygiene that the present editors, who are assistant medical officers in the Public Health Department of the London County Council, have found it necessary to make numerous additions and deletions to bring the book up to date. The principal additions which have been made in the present volume are the descriptions of the Public Health Act of 1936, the Housing Act of 1936, the Factories Act of 1937 and the Food and Drugs Act of 1938. The sections on diet, school hygiene, maternity and child welfare, speech defects, infectious diseases and mental deficiency have also undergone revision. The work, like previous editions, will form a valuable guide to those seeking information on the various departments of public health.

Mental Disorders in Modern Life

An Outline of Hopeful Treatment. By Dr. Isabel Emslie Hutton. Pp. xiii+204. (London: William Heinemann (Medical Books), Ltd., 1940.) 3*s*. 6*d*. net.

THIS little work, which is based on many years experience of mental diseases not only in Great Britain but also on the Continent and in America, is primarily intended for non-medical readers, especially magistrates, coroners and social workers, but it will also prove a useful introduction to the study of psychiatry, particularly in its practical aspects, by the medical student and graduate. In spite of its subtitle the book is not confined to treatment but also contains a concise and lucid account of the history, causes, symptoms and legal aspects of the various forms of mental disease. Special chapters are devoted to the discussion of mental deficiency, sterilization and research. In the last chapter Dr. Hutton maintains that the most important development of the future lies in the out-patient clinic, where all who feel mentally ill can openly come for treatment.

FORTHCOMING BOOKS OF SCIENCE

Mathematics: Mechanics: Physics

D. Appleton-Century Co., Ltd. Mathematics in General Education—V. T. Thayer.

Blackie & Son, Ltd. The Student's Physics, Vol. 2: Acoustics—Alexander Wood (Royal Institution Christmas Lectures). University Physics, Vol. 2: Heat—F. C. Champion.

Cambridge University Press. A Mathematician's Apology—G. H. Hardy. Electron Inertia Effects (Cambridge Physical Tracts)—F. B. Llewellyn. The Indian Mathematician Ramanujan—G. H. Hardy. The Theory and Applications of Harmonic Integrals—W. V. D. Hodge. Statistical Calculation for Beginners—E. G. Chambers. Vital Arithmetic and Geometry—R. S. Williamson.

Chapman & Hall, Ltd. Tables for the Identification of Molecular Spectra—R. W. B. Pearse and A. G. Gaydon. Classical and Modern Physics—Harvey E. White. General Physics for Students of Science—R. B. Lindsay. Principles and Practice of Chromatography—L. Zechmeister and L. Cholnoky, translated by A. L. Bacharach and F. A. Robinson. Statistical Mechanics—J. E. Mayer and M. G. Mayer. Motion and Time Study (second edition)—Ralph M. Barnes.

McGraw-Hill Book Co., Ltd. The Development of Mathematics—E. T. Bell. Statistical Procedures and their Mathematical Bases—Charles C. Peters and Wallis R. Van Voorhis. Theory of Plates and Shells—S. P. Timoshenko. Experimental College Physics (second edition)—M. W. White.

Methuen & Co., Ltd. The Special Theory of Relativity—Herbert Dingle. The Physical Principles of Wireless (Methuen's Monographs on Physical Subjects) (fourth edition, revised and enlarged)—J. A. Ratcliffe.

Oliver & Boyd, Ltd. Waves (University Mathematical Texts)—Charles Coulson.

Oxford University Press. The Separation of Gases (International Series of Monographs on Physics)—M. Ruhemann. Algebra: a Text-Book of Determinants, Matrices and Quadratic Forms—W. L. Ferrar.

University Tutorial Press, Ltd. Textbook of Light (seventh edition)—R. W. Stewart and John Satterly, revised by Charles T. Archer. Intermediate Electricity (new edition)—Robert W. Hutchinson.

Engineering

D. Appleton-Century Co., Ltd. Getting Acquainted with Radio—Alfred Morgan.

Edward Arnold & Co. Analytical Processes: a Physico-Chemical Interpretation (second edition)—T. B. Smith.

Blackie & Son, Ltd. The High Speed Internal Combustion Engine (third edition)—Harry R. Ricardo. The High-Speed Compression-Ignition Engine—C. B. Dicksee. Internal-Combustion Engineering—A. T. J. Kersey. Transformers—Eric E. Wild.

Chapman & Hall, Ltd. Thermionic Tubes at Very High Frequencies—A. F. Harvey. Electric Power Stations—T. H. Carr. Circuit Analysis for Electrical Engineers—Members of the Staff of the Department of Electrical Engineering, Massachusetts Institute of Technology. Design of Electrical Apparatus (second edition)—J. J. Kuhlmann. Electrical Communication (second edition)—A. L. Albert. Aircraft Engines, Vol. 2—A. W. Judge. Elements of Acoustical Engineering—H. F. Olson. Practical Solution of Torsional Vibration Problems (second edition)—W. Ker Wilson. The Rigid Frame Bridge (second edition)—Arthur G. Hayden.

Constable & Co., Ltd. Practical Design of Simple Steel Structures, Vol. 2 (new edition)—David S. Stewart.

Charles Griffin & Co., Ltd. The Dry Battery: a Practical Manual, including Battery Manufacture—Waring S. Sholl.

Hutchinson & Co., Ltd. Works Boiler Plant—F. J. Matthews.

Crosby Lockwood & Son, Ltd. Portable Producer Gas Plants for Road Transport: a Handbook describing the Various Types of Plant, with Practical Notes on their Use and Up-keep—H. Scott Hall and M. S. Horner.

McGraw-Hill Book Co., Ltd. Handbook of Applied Hydraulics—Calvin V. Davis. Aircraft Instruments—George E. Irwin. Practical Tunnel Driving—H. W. Richardson and Robert S. Mayo. Applied Heat Transmission—H. J. Stoever. Mechanical Vibrations (second edition)—J. P. Den Hartog. Engineering Mechanics (second edition)—S. P. Timoshenko and D. H. Young.

Oxford University Press. Relaxation Methods in Engineering Science (Oxford Engineering Science Series)—R. V. Southwell.

Sir Isaac Pitman & Sons, Ltd. Power System Interconnection (Transmission Problems)—H. Rissik. Engineering Inspection—A. C. Parkinson. Introducing Radio Receiver Servicing—E. M. Squire. Gear Design—H. E. Merritt. Experimental Radio Engineering—E. T. A. Rapson. Airscrews (Variable Pitch)—W. J. Speller. Mechanical Testing of Metallic Materials—R. A. Beaumont. Mechanical Engineering: the Profession and its Opportunities—W. H. Atherton. Rate-fixing and Estimating for Engineers—Joseph Freeman. Speech Signals in Telephony—A. Lloyd James.

University Tutorial Press, Ltd. Electrical Engineering, Vol. 2—W. Tolmé Maccall.

Chemistry: Chemical Industry

Chapman & Hall, Ltd. Hydrogen Ions: their Determination and Importance in Pure and Industrial Chemistry (third edition)—Hubert T. S. Britton. The Systematic Identification of Organic Compounds (second edition)—Ralph L. Shriner and Reynold C. Fuson. Chemical Computations and Errors—Thomas B. Crumpler and John H. Yoe. Handbook of Chemical Microscopy, Vol. 2: Chemical Methods and Inorganic Qualitative Analysis (second edition)—E. M. Chamot and C. W. Mason. An Introduction to Organic Chemistry (fifth edition)—Alexander Lowy and Benjamin Harrow. An Introduction to Organic Chemistry (second edition)—Ira D. Garard. The Chemical Analysis of Ferrous Alloys and Foundry Materials—E. C. Pigott. Twelfth Report of the Committee on Catalysis—Members of the National Research Council. Quantitative Analysis (second edition)—W. C. Pierce and E. L. Haenisch.

Constable & Co., Ltd. Chemical Thermodynamics: an Introduction to General Thermodynamics and its Applications to Chemistry (new edition)—J. R. Partington.

English Universities Press, Ltd. Modern Chemistry—B. C. Saunders and R. E. D. Clark.

Charles Griffin & Co., Ltd. The Analysis of Minerals and Ores of the Rarer Elements (second edition)—W. R. Schoeller and A. R. Powell. Spectrochemical Analysis of Metals and Alloys—F. Twyman.

Hutchinson & Co., Ltd. Cosmetic Art and Science—Fred Winter.

McGraw-Hill Book Co., Ltd. A Laboratory Course in General Chemistry—R. H. Crist. Experiments in Colloid Chemistry—Ernst A. Hauser and Lynn J. Edward. Practice of Organic Chemistry (third edition)—H. Adkins, S. W. McElvain and H. W. Klein. Physical Chemistry for Colleges (fifth edition)—E. B. Millard.

Methuen & Co., Ltd. Photosynthesis—E. C. C. Baly. Numerical and Constitutional Exercises in Organic Chemistry—J. B. L. Smith and M. Rindl.

Technology

Basil Blackwell. Modern Paper-Making (second edition)—R. H. Clapperton and William Henderson.

Cambridge University Press. The Scientific Photographer—A. S. C. Lawrence.

Chapman & Hall, Ltd. Coal: its Properties, Analysis, Classification, Geology, Extraction, Uses and Distribution (second edition)—Elwood S. Moore. Canning Practice and Control (second edition)—Osman Jones and T. W. Jones. Plastics in Industry—'Plastes'. Silver in Industry—edited by Lawrence Addicks. Photographic Facts and Formulas (new edition)—E. J. Wall.

Charles Griffin & Co., Ltd. Cutting Tools for Metal Machining—Max Kurrein and F. C. Lea.

McGraw-Hill Book Co., Ltd. Press Working of Metals—C. W. Hinman.

Sir Isaac Pitman & Sons, Ltd. The Iron and Steel Industry—G. Brown and A. L. Orford.

Astronomy

Macmillan & Co., Ltd. The Birth and Death of the Sun—George Gamow.

Meteorology: Geophysics

McGraw-Hill Book Co., Ltd. Weather Analysis and Forecasting—Sverre Petterssen. Physics of the Air (third edition)—W. J. Humphries.

Geology: Mineralogy

Cambridge University Press. The West Highlands and the Hebrides: a Guide for Amateur Geologists—the late Alfred Harker, edited by J. E. Richey.

McGraw-Hill Book Co., Ltd. Methods of Study in Sediments—W. H. Twenhofel.

Geography: Travel

B. T. Batsford, Ltd. Chiltern Country (Face of Britain Series)—H. J. Massingham. English Lakeland (Face of Britain Series)—Doreen Wallace. Cambridge—John Steegmann.

Basil Blackwell. Norway: the Northern Playground—W. Cecil Slingsby.

Cambridge University Press. Landscape: as Developed by the Processes of Normal Erosion—C. A. Cotton. Mexico: a New Spain with Old Friends—J. B. Trend.

Jonathan Cape, Ltd. Assam Adventure—F. Kingdon Ward. Kabloona—Gontran de Poncins, in collaboration with Lewis Galantière.

Cassell & Co., Ltd. The Prodigious Caribbean: Columbus to Roosevelt—Rosita Forbes.

Chapman & Hall, Ltd. College Geography (second edition)—E. C. Case and D. R. Bergsmark.

J. M. Dent & Sons, Ltd. Sweet Thames run Softly—Robert Gibbings. Ten Great Mountains—R. L. G. Irving.

Robert Hale, Ltd. Cape Horn—Capt. Felix Riesenberg. Cherry Kearton's Travels—Cherry Kearton. Polynesian Paradise—Donald Sloan. Our Arabian Nights—Ruth and Helen Hoffman. Alaska Challenge—Ruth and Bill Albee. One Man against the North—David Irwin.

George G. Harrap & Co., Ltd. The Story of the Pacific—Hendrik Willem Van Loon.

Hodder & Stoughton, Ltd. Sons of Sindbad: 10,000 Miles Sailing with the Arabs in their Dhows—Alan Viliers. I went to Tristan—Allan Crawford.

Jarrolds Publishers (London), Ltd. Jungle in the Clouds—Victor W. v. Hagen.

Herbert Jenkins, Ltd. Easy Going—Rex Tremlett. Savoy! Corsica! Tunis!—Bernard Newman. Distant Horizons—Carl Shreve. A Greenhorn in Africa—Roger Courtney. Wanderings through Many Counties with Field-Glass, Note-Book and an Observing Eye—James J. Cash.

Longmans, Green & Co., Ltd. Deltaic Formation with Special Reference to the Bengal Delta—C. Strickland.

Methuen & Co., Ltd. The Silent Traveller in the Yorkshire Dales—Chiang Yee. England without End—John R. Allan. Africa (new and revised edition)—Walter FitzGerald.

University of London Press, Ltd. The British Isles—David L. Linton.

General Biology: Natural History
Botany: Zoology

George Allen & Unwin, Ltd. Evolution: the Modern Synthesis—Julian Huxley.

Cambridge University Press. International Wildfowl Inquiry, Vol. 1.

Jonathan Cape, Ltd. The Advance of the Fungi—E. C. Large.

Chapman & Hall, Ltd. Insect Pests in Stored Products—H. Hayhurst. Elements of Botany (third edition)—Richard M. Holman and Wilfred W. Robbins.

J. & A. Churchill, Ltd. Plant Physiology (second edition)—Meirion Thomas.

Lindsay Drummond, Ltd. Trees: a Book of the Seasons—Richard St. Barbe Baker. Lundy, Isle of Puffins—Richard Perry.

Robert Hale, Ltd. Jungle Friends—Osa Johnson. Animals are like That!—Frank Buck.

Hutchinson & Co., Ltd. Biological Botany—R. Ruggles-Gates.

McGraw-Hill Book Co., Ltd. This Living World—C. C. Clark and R. H. Hall. Entomophagous Insects—Curtis P. Clausen. Embryology of the Insects and Myriapods—O. A. Johannsen and F. H. Butt. Elements of Botanical Microtechnique—J. E. Sass.

Oxford University Press. Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies. Supplement 1921–35 to Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns—W. C. Worsdell.

Frederick Warne & Co., Ltd. Wayside and Woodland Trees—Edward Step (new edition by A. Keith Jackson and A. B. Jackson).

Agriculture: Horticulture: Forestry

Baillière, Tindall & Cox. The Diseases of the Coconut Palm—the late H. R. Briton Jones, edited by E. E. Cheesman.

B. T. Batsford, Ltd. Corn Country—C. Henry Warren.

Cambridge University Press. The Seasons and the Gardener—H. E. Bates.

Chapman & Hall, Ltd. Practical Poultry Management (fourth edition)—James E. Rice and Harold E. Botsford. Judging Dairy Cattle—Edwin S. Harrison.

McGraw-Hill Book Co., Ltd. Soils and Soil Management—A. F. Gustafson. Commercial Timbers of the United States (second edition)—H. P. Brown and A. J. Panshin. Textbook of Dendrology (second edition)—W. M. Harlow and E. S. Harrar.

Oxford University Press. Colonial Forest Administration—the late R. S. Troup. Elementary Manual of Indian Forest Utilization—H. Trotter.

Anatomy: Physiology

D. Appleton-Century Co., Ltd. A Text-book of Histology—H. E. Jordan.

Anthropology: Archæology

D. Appleton-Century Co., Ltd. Acculturation in Seven American Indian Tribes—Ralph Linton.

B. T. Batsford, Ltd. Prehistoric England (British Heritage Series)—Grahame Clark.

W. & R. Chambers, Ltd. Prehistoric Communities of the British Isles—V. Gordon Childe.

Cresset Press, Ltd. The Tower of Five Glories: a Study of the Min Chia of Ta Li, Yunnan—C. P. FitzGerald.

George G. Harrap & Co., Ltd. Witchcraft—William Seabrook.

Lawrence & Wishart, Ltd. Aeschylus and Athens—George Thomson.

Longmans, Green & Co., Ltd. Hindu Social Institutions: with Reference to their Psychological Implications—Pandharinath H. Valavalkar.

McGraw-Hill Book Co., Ltd. The Great Cultural Tradition—Ralph E. Turner.

Oxford University Press. The Social and Economic History of the Hellenistic World—M. Rostovtzeff. Cisalpine Gaul: Social and Economic History from 49 B.C. to the Death of Trajan—G. E. F. Chilver. Lachish II: the Fosse Temple—Edited by Olga Tufnell, C. H. Inge and Lankaster Harding. A History of the Giza Necropolis—George A. Reisner. Modern India and the West—Edited by L. S. S. O'Malley. The Transformation of Islamic Society: a Study of the Impact of Western Civilization on Moslem Culture in the Near East. Vol. 1: Islamic Society in the Eighteenth Century—H. A. R. Gibb and Harold Bowen.

Philosophy: Psychology

George Allen & Unwin, Ltd. An Inquiry into Meaning and Truth—Bertrand Russell. The Analysis of Knowledge—Ledger Wood. The Problems of Logic—Andrew Paul Ushenko. Heaven Wasn't his Destination: the Philosophy of Ludwig Feuerbach—William B. Chamberlain. I Believe: a Book of Living Philosophies.

D. Appleton-Century Co., Ltd. Emotion and Conduct in Adolescence—Caroline B. Zachry, in collaboration with Margaret Lighty.

Cambridge University Press. Man on his Nature—Sir Charles Sherrington (The Gifford Lectures). Political Propaganda—F. C. Bartlett.

J. & A. Churchill, Ltd. The Human Mind: the Organ of Thought in Function and Dysfunction—Murdo Mackenzie.

English Universities Press, Ltd. Straight Thinking in War-Time—Robert H. Thouless. Teach Yourself Psychology (Teach Yourself Series)—Arnold Bellwood.

Hamish Hamilton. Ltd. Stammering and Speech Therapy—W. Kingdon Ward.

Longmans, Green & Co., Ltd. Psychoanalytic Method—Roland Dalbiez.

McGraw-Hill Book Co., Ltd. Education for the Good Life—Franklin Bobbitt. Psychodynamics of Abnormal Behavior—J. F. Brown. Audio-Visual Aids to Instruction—Harry C. McKown and Alvin B. Roberts.

Methuen & Co., Ltd. An Essay on the Metaphysics of Descartes—M. Versfeld. Science versus Materialism—R. O. Kapp. Psychology: a Study of Mental Life—Robert S. Woodworth.

Oxford University Press. Hume's Theory of the External World—H. H. Price. Morality and Freedom in the Philosophy of Immanuel Kant (Oxford Classical and Philosophical Monographs)—W. T. Jones.

Sir Isaac Pitman & Sons, Ltd. The Stammerer Unmasked—R. Macdonald Ladell.

George Routledge & Sons, Ltd. Personality and Mental Illness—John Bowlby. The Philosophy of Peirce (International Library of Psychology, Philosophy and Scientific Method)—Justus Buchler.

University of London Press, Ltd. The Factors of the Mind—Cyril Burt.

Bacteriology: Hygiene

Edward Arnold & Co. Modern Drugs in General Practice—Ethel Browning.

Chapman & Hall, Ltd. Public Water Supplies (fourth edition)—F. E. Turneaure, H. L. Russell and M. S. Nichols. Sewage Treatment—Karl Imhoff and Gordon M. Fair.

Miscellany

D. Appleton-Century Co., Ltd. Science on Parade—A. Frederick Collins. The Pan-American Highway: from the Rio Grande to the Canal Zone—Harry A. Franck and Herbert C. Lanks.

Chapman & Hall, Ltd. A Handbook of English in Engineering Usage (second edition)—A. C. Howell.

Chatto & Windus. The Uniqueness of Man—Julian Huxley.

Robert Hale, Ltd. The Art of Camouflage—Lieut.-Col. C. H. R. Chesney.

Lawrence & Wishart, Ltd. Science in Peace and War—J. B. S. Haldane.

McGraw-Hill Book Co., Ltd. Technical Exposition—Leslie M. Oliver.

Macmillan & Co., Ltd. The Social Relations of Science—J. G. Crowther.

Methuen & Co., Ltd. The Cambridge Evacuation Survey—Susan Isaacs, R. H. Thouless, S. Clement Brown and others. Speech and Voice: their Pathology and Therapy in the Light of Evolution—Leopold Smith. General Science, Part 2—J. C. Platt, Freda Jones and J. H. Hopkinson.

Sir Isaac Pitman & Sons, Ltd. Science for Girls. Book 3—W. B. Little.

RECENT SCIENTIFIC AND TECHNICAL BOOKS

*Volumes marked with an asterisk (*) have been received at "*NATURE*" Office*

Mathematics: Mechanics: Physics

Allen, R. M. The Microscope. Med. 8vo. Pp. viii + 286. (London: Chapman and Hall, Ltd., 1940.) 15*s*. net.*

Bhagavantam, S. Scattering of Light and the Raman Effect. Imp. 8vo. Pp. x +333 +2 plates. (Waltair: Andhra University, 1940.) 15 rupees; 22*s*. net.*

Richardson, E. G. Physical Science in Art and Industry. Demy 8vo. Pp. xi +293 +6 plates. (London: English Universities Press, Ltd., 1940.) 15*s*. net.*

Stead, G. Elementary Physics: for Medical, First Year University Science Students and General Use in Schools. Sixth edition. Demy 8vo. Pp. xiv +562. (London: J. and A. Churchill, Ltd., 1940.) 12*s*. 6*d*.*

Wilson, O. Spaced Test Papers in Physics. Roy. 8vo. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1940.) 2*s*. 3*d*.

Engineering

Baker, T. Land and Engineering Surveying. Twenty-fifth edition, revised by G. L. Leston. Cr. 8vo. Pp. 64. (London: The Technical Press, Ltd., 1940.) 15*s*. net.

Hartshorn, L. Radio-Frequency Measurements by Bridge and Resonance Methods. (Monographs on Electrical Engineering, Vol. 10.) Demy 8vo. Pp. xv +265. (London: Chapman and Hall, Ltd., 1940.) 21*s*. net.*

Hill, F. T. The Materials of Aircraft Construction. Fourth edition. Demy 8vo. Pp. ix + 449. (London: Sir Isaac Pitman and Sons, Ltd., 1940.) 20*s*. net.

Rubey, Harry; Lommel, George Edward, and Todd, Marion Wesley. Engineering Surveys. (Engineering Science Series.) Revised edition. Cr. 8vo. Pp. xv +322 + 142. (New York: The Macmillan Company, 1940.) 15*s*. net.*

Chemistry: Chemical Industry

Gyngell, Eric S. Applied Chemistry for Engineers. Demy 8vo. Pp. viii +328. (London: Edward Arnold and Co., 1940.) 15*s*. net.*

Lowy, Alexander, and Harrow, Benjamin. An Introduction to Organic Chemistry. Fifth edition. Med. 8vo. Pp. 400. (London: Chapman and Hall, Ltd., 1940.) 18*s*. net.

Moelwyn-Hughes, E. A. Physical Chemistry: an Introduction. Imp. 8vo. Pp. viii +660. (Cambridge: At the University Press, 1940.) 45*s*. net.*

Morgan, Alfred. Things a Boy can Do with Chemistry. Demy 8vo. Pp. 305. (New York and London: D. Appleton-Century Co., Inc., 1940.) 10*s*. 6*d*. net.

Pierce, Willis Conway, and Haenisch, Edward Louth. Quantitative Analysis. Second edition. Med. 8vo. Pp. 462. (London: Chapman and Hall, Ltd., 1940.) 18*s*. net.

Technology

Benfield, Eric. Purbeck Shop: a Stoneworker's Story of Stone. Demy 8vo. Pp. xvi +172 +9 plates. (Cambridge: At the University Press, 1940.) 12*s*. 6*d*. net.

French, Thomas E., and Svenson, C. L. Mechanical Drawing. Fourth edition. Med. 8vo. Pp. 300. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 11*s*. 6*d*.

Garrard, F. J. Watch Repairing, Cleaning and Adjusting. New edition. Cr. 8vo. (London: The Technical Press, Ltd., 1940.) 6*s*. net.

General Biology: Natural History Botany: Zoology

Dawson, A. J. Everybody's Dog Book. New edition. Demy 8vo. Pp. viii + 231. (London: Philip Allan and Co., Ltd., 1940.) 5*s*. net.

Ellerman, J. R. The Families and Genera of Living Rodents. Vol. 1. Roy. 8vo. Pp. 689. (London: Oxford University Press, 1940.) 35*s*. net.

Goldschmidt, Richard. The Material Basis of Evolution. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Med. 8vo. Pp. xi +436. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1940.) 30*s*. net.*

Hubbard, C. E., and Vaughan, R. E. The Grasses of Mauritius and Rodriguez. Roy. 8vo. Pp. 128. (Mauritius: Director of Agriculture; London: The Crown Agents for the Colonies, 1940.) 4*s*. 6*d*.; 3 rupees.*

Romany of the B.B.C., Edited by. The "Out with Romany" Calendar, 1941. Sup. Roy. 8vo. Pp. 56. (London: University of London Press, Ltd., 1940.) 3*s*. 6*d*. net.*

Verrill, A. Hyatt. Wonder Creatures of the Sea. Demy 8vo. Pp. 288. (New York and London: D. Appleton-Century Co., Inc., 1940.) 15*s*. net.

Agriculture: Horticulture: Forestry

Anthony, David J. Diseases of the Pig and its Husbandry. Demy 8vo. Pp. ix + 272. (London: Baillière, Tindall and Cox, 1940.) 10*s*. 6*d*. net.

Grainger, John. Garden Science. Cheap edition. Imp. 16mo. Pp. 265. (London: University of London Press, Ltd., 1940.) 2*s*. 6*d*. net.*

Gray, Ernest. Diseases of Poultry: their Aetiology, Diagnosis, Treatment and Control; with a Section on the Normal Anatomy and Physiology of the Fowl. (Lockwood's Agricultural and Horticultural Handbooks.) Demy 8vo. Pp. x +198 +16 plates. (London: Crosby Lockwood and Son, Ltd., 1940.) 9*s*. 6*d*. net.*

Anatomy: Physiology

Cameron, A. T. Recent Advances in Endocrinology. Fourth edition. Demy 8vo. Pp. vii + 432. (London: J. and A. Churchill, Ltd., 1940.) 18*s*. net.

Grant, J. C. Boileau. A Method of Anatomy. Second edition. 8vo. Pp. 794. (London: Baillière, Tindall and Cox, 1940.) 33*s*. net.

Philosophy: Psychology

Ayer, Alfred J. The Foundations of Empirical Knowledge. Demy 8vo. Pp. x +276. (London: Macmillan and Co., Ltd., 1940.) 10*s*. 6*d*. net.*

Price, Harry. "The Most Haunted House in England": Ten Years' Investigation of Borley Rectory. Demy 8vo. Pp. x +255 +8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 10*s*. 6*d*. net.*

Thorndike, E. L. Human Nature and the Social Order. Demy 8vo. Pp. xx +1020. (New York: The Macmillan Company, 1940.) 18*s*. net.*

Watson, E. L. Grant. Man and his Universe. Demy 8vo. Pp. 192. (London: Hutchinson and Co. (Publishers), Ltd., 1940.) 10*s*. 6*d*. net.

Weymouth, Anthony. A Psychologist's War-Time Diary. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 12*s*. 6*d*. net.

Miscellany

Clynes, J. R. When I Remember . . . (Macmillan War Pamphlets, No. 6.) Cr. 8vo. Pp. 32. (London: Macmillan and Co., Ltd., 1940.) 3*d*. net.*

Forster, E. M. Nordic Twilight. (Macmillan War Pamphlets, No. 3.) Cr. 8vo. Pp. 32. (London: Macmillan and Co., Ltd., 1940.) 3*d*. net.*

Halifax, Viscount. Speeches on Foreign Policy. Edited by H. H. E. Craster. (Issued under the auspices of the Royal Institute of International Affairs.) Demy 8vo. Pp. x +368. (London, New York and Toronto: Oxford University Press, 1940.) 10*s*. 6*d*. net.*

Woolf, Leonard. The War for Peace. Ex. Cr. 8vo. Pp. x +244. (London: George Routledge and Sons, Ltd., 1940.) 7*s*. 6*d*. net.*

(*Continued from page 542.*)

by the Uppsala school. The agreement between the two series is fair, especially as the temperature is doubtful.

Cytochrome C. This protein was centrifuged in order to determine the lower limit of molecular weights resolvable. The sedimentation constant S_{20} $2 \cdot 1 \times 10^{-13}$ cm./sec. for a 0·7 per cent solution in phosphate buffer at *p*H 7·3 agrees well with that obtained by Anderson and Pederson[8] (S_{20}, $1 \cdot 9 \times 10^{-13}$).

A globulin arachin from the ground nut (*Arachis hypogaea*). Preliminary runs on this protein indicate the existence of five different groups of molecular weights dependent on the nature of the salt used to effect solution.

The sedimentation constant, diffusion constant and molecular weight are tabulated below (Table 2) together with the shape factor, which indicates an increasing globular shape with decrease in molecular weight.

TABLE 2. ARACHIN.

Group	S_{20}	D_{20}	Mol. Wt.	Shape factor
I	$13 \cdot 8 \times 10^{-13}$	$2 \cdot 0 \times 10^{-7}$	600,000	1·92
II	11·2	2·4	400,000	1·84
III	7·4	5·0	140,000	1·30
IV	3·25	10·0	30,000	1·05
V	1·75	9·3	20,000	1·21

These fractions of differing molecular weights were obtained by treating the protein with lyotropic salts; different salts either extracted different preformed globulins or effected different decompositions of one globulin, but no salt produced a diagram showing all five groups; dilute ammonia solutions revealed the presence of groups II, III, and V in the extract. The diagrams for ammonia are reproduced (Fig. 2 *a*). During solubility tests of the protein in lyotropic solvents, it was found that the salts fell into three groups. It is interesting to note that the presence or absence of some of the five groups places the sedimentation diagrams into the same three classes.

Carbonic Anhydrase. Prof. D. Keilin kindly provided us with a sample of carbonic anhydrase which had been centrifuged by Dr. Philpot at Oxford (unpublished result), but in no way did the two diagrams resemble one another. The diagram obtained by Dr. Philpot was typical of that obtained with a fibrous protein, with a sedimentation constant of about $S_{20} = 3 \times 10^{-13}$. The diagram (Fig. 2 *b*) obtained with the fresh sample was very much like a globular protein with a sedimentation constant of S_{25} $3 \cdot 80 \times 10^{-13}$. This first sample had been prepared using neutral salts as precipitants, so a further sample prepared by acetone precipitation was obtained; here again the diagram (Fig. 2 *c*) was similar to that of a globular protein with a sedimentation constant of $S_{25} = 3 \cdot 90 \times 10^{-13}$. Finally, it was suspected that perhaps some acetone had been retained by the sample sent to Dr. Philpot; a solution of carbonic anhydrase in a 14·3 per cent acetone solution was analysed. This time the diagram (Fig. 2 *d*) is exactly similar to that obtained by Dr. Philpot, the sedimentation constant being $S_{25} = 3 \cdot 20 \times 10^{-13}$. The diagram is typical of a fibrous protein and agrees with Dr. Philpot's to the extent of having the same minor 'peak' near the bottom of the cell which does not appear to move at all during the run. Though the amount of acetone is high there seems little doubt, in view of the identity of diagrams, that this is the reason for the anomaly shown by the early centrifuge diagrams. Table 3 shows a summary of the data on carbonic anhydrase.

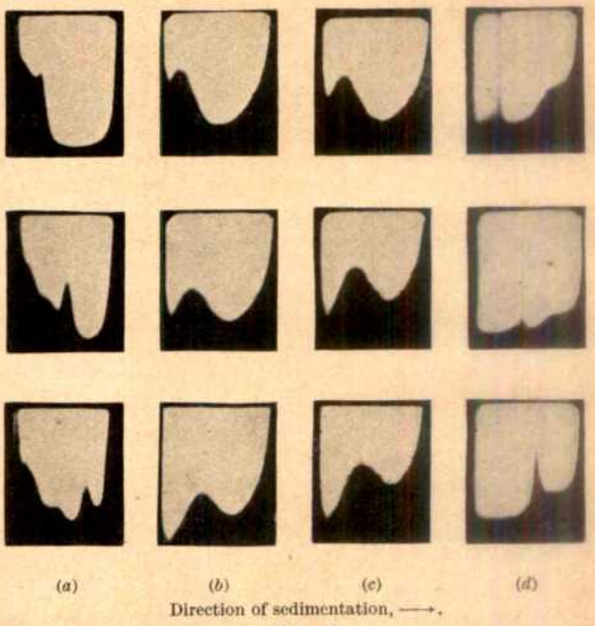


Fig. 2.

SEDIMENTATION DIAGRAMS. (*a*) GLOBULIN FRACTION IN $N/10$ AMMONIA; (*b*) CARBONIC ANHYDRASE SALT PRECIPITATION; (*c*) CARBONIC ANHYDRASE ACETONE PRECIPITATION; (*d*) CARBONIC ANHYDRASE IN 14·3 PER CENT ACETONE SOLUTION.

TABLE 3.

	Run 72	Run 73	Run 76
Substance	0·6% carbonic anhydrase	0·6% carbonic anhydrase ppt. by acetone + acetone dialysed	0·6% carbonic anhydrase acetone prep.
Solvent	0·2 *M* NaCl	0·2 *M* NaCl	14·3% acetone 86·7% 0·2 *M* NaCl
Gravitational force	222,000	220,000	240,000
Sedimentation constant × 10^{-13} 25° C.	3·80	3·90	$3 \cdot 20 \times 10^{-13}$

It should be mentioned that the diagrams shown have not been corrected for the reference diagrams, which have been omitted.

We have to thank Mr. R. P. Sinclair for considerable assistance. Our thanks are also due to Dr. Philpot for many discussions, to the Sharples Centrifuge Co., the Royal Society and Imperial Chemical Industries, Ltd., for financial and technical assistance.

Owing to the present international situation, it has not proved possible to obtain the collaboration of my co-worker, Dr. F. R. Eirich, in writing this brief survey of work on the air-driven ultracentrifuge. Whilst he might not agree in detail with some of the observations made therein, he expressed an earnest desire for these results to be communicated as soon as was conveniently possible.—E. K. R.

[1] Pickels, E. G., *Rev. Sci. Inst.*, **9**, 358 (1938).
[2] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9, 124 and 152.
[3] Bjornstahl, Y., *Rev. Sci. Inst.*, **10**, 258 (1939).
[4] Philpot, J. St. L., NATURE, **141**, 283 (1938).
[5] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9 and 297.
[6] Weiner, O., *Ann. Phys. und Chem.*, N.F. **49**, 105 (1893).
[7] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9 and 382.
[8] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), p. 390.

OBITUARIES

Prof. R. T. Hewlett

RICHARD TANNER HEWLETT, a well-known and highly respected figure in British bacteriology for some forty-five years, died on September 10 at the age of seventy-five. Educated at King's College School and trained for his professional career at the King's College School of Medicine, Hewlett graduated M.B. Lond. in 1890 and for three years acted as demonstrator in bacteriology, eventually in 1901 succeeding to the chair of bacteriology vacated by his chief, Prof. Edgar Crookshank. In the interval he had served (1894–1901) on the bacteriological staff of the British Institute of Preventive Medicine under its then director, Dr. Allan Macfadyen. During his career he also acted as director of pathology and later as consulting pathologist at the Seamen's Hospital, and for many years he lectured on bacteriology at the London School of Tropical Medicine.

Hewlett's interests lay almost entirely in the application of bacteriology to hygiene and public health, and numerous articles from his pen on a diversity of subjects—water pollution, shell-fish and sewage contamination, pure milk supplies, cellular contents of milk, insect carriers of disease, etc.—will be found in the appropriate journals from 1897 onwards. He was particularly interested in the disinfection process and in methods of testing disinfectants, to which subject he devoted his Milroy Lectures before the Royal College of Physicians in 1909. In these lectures he expressed the view that the similarity of certain disinfection curves to that of a monomolecular reaction was only apparent, and that the course of disinfection processes generally was most probably to be accounted for by the assumption of a variation of resistance existing among the individuals in the bacillary population exposed—a view which has since been widely ventilated and experimentally tested.

At the British Institute of Preventive Medicine, Hewlett had been greatly intrigued by the experiments of Macfadyen and Rowland on the extraction of cell juices from yeasts and bacteria by grinding at the temperature of liquid air. Later, with the help of his former colleague Mr. J. E. Barnard, an improved grinding apparatus was devised, and the results obtained by immunization of animals with such juices (endotoxins) were communicated to the Royal Society in 1909 and 1911. Assay of this work, which unfortunately was not carried far enough or conducted on a sufficiently large scale, is difficult even now; but it still has its interest for workers occupied with the more detailed analysis of bacterial antigens on modern chemical and serological lines.

Hewlett was widely read in his subject and wrote with ease. His student text-books on "General and Special Pathology" and on "Applied Bacteriology" have had a large vogue for many years. To the "System of Bacteriology" he contributed important articles, and the columns of NATURE contain many contributions from his pen. In recent years he took a great interest in the work of the Royal Microscopical Society, of which he was honorary secretary at his death. Unassuming and ever helpful and friendly in his human relations, Hewlett leaves a pleasant memory, and the undersigned records with gratitude the interest he maintained in the work and affairs of the Lister Institute, where he served an apprenticeship in the 'nineties. To his widow and family our sincere sympathy is extended.

J. C. G. LEDINGHAM.

Prof. H. Stroud

HENRY STROUD was born at Bristol on August 7, 1861. He began his education at Bristol Grammar School and proceeded with an entrance scholarship in 1879 to the University College in that city, where he came under the influence of Silvanus Thompson. In 1880 he was awarded the Gilchrist Scholarship tenable at Owens College, Manchester, where he studied under Balfour Stewart and Henry Roscoe for two years, at the end of which period he apparently scooped up all the mathematical and physical scholarships in his immediate neighbourhood and went with them to St. John's College, Cambridge. In the

Mathematical Tripos list for 1885 he was eighth Wrangler. In 1886 he obtained a first class in physics in Part II of the Natural Sciences Tripos, and in the same year graduated as doctor of science in the University of London.

Stroud was appointed lecturer in physics at the College of Physical Science (which later became Armstrong College and is now King's College), Newcastle-upon-Tyne, in 1886 and was elected professor a year later. In the following years he became a strong believer in the value of popular scientific lectures, and many will remember his numerous experimentally illustrated lectures given in towns and villages throughout the northern counties of England on X-rays, radium and wireless telegraphy at a time when these subjects were in their infancy. He played an important part in the development of the institution as a self-contained university college and as a unit of the University of Durham.

For several years Stroud was associated with the late Lord Armstrong in his researches on "Electric Movements in Air and Water". Although he published little himself, he was always keenly interested in research and he endowed various college prizes with a view to its encouragement. On his retirement in 1926, after forty strenuous sessions in harness, he was elected professor emeritus by a college grateful for his valuable services. Stroud died in peaceful seclusion at Gerrard's Cross on September 3.

George W. Todd.

Colonel H. L. Crosthwait, C.I.E.

Herbert Leland Crosthwait, who died on September 11, aged seventy-two, was the eldest son of the late Mr. Samuel Crosthwait, of The Lodge, Bagenalstown, County Carlow, Ireland, and educated at Rossall and at Trinity College, Dublin. He entered the Royal Engineers in 1890. Two years later he went to India and in 1897 he joined the Survey of India, in which he remained for the rest of his service. Here he soon became well known for his very extended knowledge of a variety of scientific subjects; in fact, if he had concentrated on any one subject he would easily have been one of the authorities on that subject. His wide knowledge and experience, however, made him a most delightful companion. He could talk well and easily and with full knowledge on many topics.

As a surveyor, Crosthwait was mostly employed on the scientific side, but quite easily switched on to the topographical branch when required, as, for example, when employed on the Chile-Argentine Boundary Commission, or during the War of 1914–18 in East Persia, and during the Waziristan Expedition and Third Afghan War of 1919–20. For these services he was awarded a C.I.E.

On his retirement Crosthwait began to specialize on the subject of air surveys and became a director of the Aircraft Operating Company, Ltd., where his knowledge of topography and his very quickly acquired knowledge of the application of air photography to map-making made him a much valued colleague. He was on the council of the Royal Geographical Society for many years, where his appreciation of the value of air photography to map-making made him a most useful member; it might, in fact, be fairly said that no one rendered better service to cartography of late years than Crosthwait did in leading air survey on the right lines; that is, to a full but not excessive appreciation of its value.

Added to his wide knowledge over an extensive range of subjects, Crosthwait had a great charm of manner, and a very human kindliness which made him a valued companion, whether in the wilds of the jungle or at a civilized meeting of the members of a scientific society. His death will leave a wide gap among his large circle of friends.

C. H. D. Ryder.

Lieut. J. H. Martin, R.N.V.R.

Lieut. James Martin, who has been reported lost at sea, had an unusual career compared with other polar explorers of the last twenty years. His whole interest was the sea, and his contributions to Antarctic discovery depended on his intimate knowledge of seamanship and his devotion to shipwork. He broke away from office work in the City to serve before the mast in the sailing ship *Garthpool*, and some years later he signed on as a seaman in the *Discovery* on a summer voyage to the Antarctic in 1929–30 under Sir Douglas Mawson. Martin shipped on her again in the following season and was ranked as boatswain. In order to improve his knowledge of ice navigation he then went to Norway for spring sealing in the White Sea and served as a seaman in the *Quest*. Soon afterwards he was chosen as leader of the 1933 Oxford University Expedition to Spitsbergen, but was prevented in the end from actually taking part owing to having been severely frostbitten whilst sledging in Northern Canada.

Martin made plans for an Antarctic expedition, but set them aside in favour of John Rymill's British Graham Land Expedition. He accordingly volunteered as one of Rymill's crew and was appointed mate in the *Penola* commanded by Lieut. R. E. D. Ryder, R.N. Much of the ship work was done under sail, in which Martin was an expert. Great size and strength, fearlessness and gentleness went to the make up of this remarkable man. Ryder has made clear how much he depended on his mate during the three years voyage, and the success of the expedition was in part due to the way these two understood each other, and worked the ship in narrow waters. When war broke out, Martin transferred to the Navy from the Grenadier Guards, in which he had held a commission in 1918, and from then for most of the time was shipmate once again with Ryder.

J. M. Wordie.

We regret to announce the death of Mr. J. B. Beresford, C.B.E., formerly secretary of the University Grants Committee, and of the Standing Committee on Museums and Galleries, as a result of enemy action, aged sixty-two.

NEWS AND VIEWS

Lieut.-Colonel J. T. C. Moore-Brabazon, M.P.

THE announcement on October 3 of the appointment of Lieut.-Colonel J. T. C. Moore-Brabazon to be Minister of Transport has been received with satisfaction by men of science. He is well known as a pioneer in motoring and aviation, and holds No. 1 certificate granted by the Royal Aero Club for pilots. Throughout his career he has brought scientific principles to bear on his work and expressions of opinion, and for this reason alone readers of NATURE will be gratified to learn of his appointment to such a ministry rendered all the more important during the present situation. Those who know Lieut.-Colonel Moore-Brabazon personally will feel even more satisfied in that the position is now being filled by a man of courage and determination. He was formerly connected with the Ministry of Transport as parliamentary secretary during two periods covering the years 1923–27. He is, at present, member of Parliament for Wallasey.

James Watt International Medal

THE council of the Institution of Mechanical Engineers has unanimously decided to award the James Watt International Medal to Prof. Aurel Stodola, of Zurich, on the recommendation of the Engineering Institute of Canada, the Czechoslovak Society of Engineers, and the Swiss Society of Engineers and Architects. The Medal was founded by the Institution in 1936 to commemorate the bicentenary of the birth of James Watt on January 19, 1736, and is awarded every two years to an engineer of any nationality who is deemed worthy of the highest award that the Institution can bestow and that a mechanical engineer can receive. In making the award the Institution has secured the co-operation of engineering institutions and societies in all parts of the world. The Medal is given for world-wide eminence in mechanical engineering in any direction, science or research, invention or production.

Mr. N. W. Pirie

THE Committee of Management of the Rothamsted Experimental Station has appointed Mr. N. W. Pirie as head of the Biochemical Section of the Station. Mr. Pirie was an exhibitioner of Emmanuel College, Cambridge, and after gaining first classes in both parts of the Natural Sciences Tripos was awarded a research studentship under Sir Frederick Gowland Hopkins in the School of Biochemistry, where later he was appointed Rockefeller demonstrator. He also gained a Rockefeller Travelling Fellowship to visit California to study certain virus disease problems, but this was interrupted by the War. At Rothamsted he will be primarily concerned with the virus diseases of crops, which at present cause great and increasing losses and for which no remedies are known. He has already, in conjunction with Mr. F. C. Bawden of Rothamsted, made important and promising investigations on this subject, and has succeeded in isolating the actual viruses causing some of the diseases.

Retirement of Dr. W. E. Collinge

DURING the twenty years of his keepership of the Yorkshire Philosophical Society's Museum in York, a post from which he is shortly to retire, Dr. W. E. Collinge has added much to the appearance and value of the exhibits there and to the scientific life of the city. The collections in the Museum are particularly rich in archæological finds, and Dr. Collinge has lost no opportunity, by museum talks and tours and by newspaper articles, of making these and the other collections under his charge a fount of enlightenment to the citizens and to many visitors from beyond the walls. His scientific work has been largely economic. Almost alone in Britain he has persistently carried on a study of the food of birds, the first results of which were collected in a modest volume in 1913, and in 1924–1927 appeared in a revised and greatly enlarged edition which remains the standard work upon the food and economic standing of British wild birds. The two editions show an interesting trend in the method of food analysis, for while the first followed the good old British plan of recording the individual items of diet, the second reveals the influence of American workers in recording foods volumetrically and thus enabling the analyses to be summarized in spectacular diagrams. It is natural that Dr. Collinge's advice on matters of bird protection should have been much sought after, and for twenty years he has been a valuable member of the Scottish Wild Birds Advisory Committee appointed to advise the Scottish Home Department in connexion with the Wild Birds Protection Acts. As a member of many societies he has taken a prominent share in the promotion of natural science and archæology in York.

Nicholas Aylmer Vigors, F.R.S., M.P. (1787–1840)

BY the death on October 26, 1840, a century ago, of Nicholas Aylmer Vigors, M.P., the Zoological Society lost one of its most active members. Born at Old Leighlin, County Carlow, in 1787, Vigors was educated at Trinity College, Oxford, and then became an ensign in the Grenadier Guards. As such he served in the Peninsula War, was present at the battle of Barossa and was severely wounded. Returning to England he devoted himself to natural history, and especially to the study of birds and insects. As a member of the Linnæan Society he was one of the first members of the Zoological Club, from which in 1826 sprang the Zoological Society, of which he became the first secretary, and to the museum of which he presented a valuable collection of insects and birds. For several years he was the principal editor of the *Zoological Journal*. His best-known papers were those "On the Natural Affinities that connect the Orders and Families of Birds" and "The Arrangement of the Genera of Birds". A land owner and a man of considerable wealth, he promoted the progress of science in various ways, while he also for several years sat in Parliament first for the city, and then for the county of Carlow. He was elected fellow of the Royal Society in 1826 and in 1832 was made a D.C.L. of Oxford.

Isolation of a Heavy Sulphur

At the hundredth meeting of the American Chemical Society, which opened at Detroit on September 9, Drs. David W. Stewart and Karl Cohen, of Columbia University, described the preparation of heavy sulphur. According to Science Service, of Washington, D.C., the researches were conducted under the direction of Prof. Harold C. Urey, head of the Department of Chemistry of the University, who received the Nobel prize for chemistry in 1934 for his work in the discovery of heavy hydrogen. Ordinary sulphur contains four isotopes; S^{32} (95 per cent); S^{34} (4 per cent), which is the isotope now isolated; S^{33} (1 per cent); and S^{36} (0·01 per cent). Separation of the isotope was achieved with Prof. Urey's counter-current scrubbing method, previously used to separate isotopes of carbon and of nitrogen. Sulphur dioxide was passed up through 150 ft. of sodium hydrogen sulphite flowing downwards. S^{34} is more soluble in the liquid than the other varieties; and, at the end of the process, the emergent liquid contained about a quarter of the heavy isotope. Researches are now being carried out by Dr. Vincent du Vigneaud, professor of biochemistry in the Cornell University School of Medicine, using heavy sulphur to determine the role of the element in the chemistry of the living organism.

Zoos in War-time

The North of England Zoological Society has maintained the collection at Chester during the first year of the War with little less than normal standards, despite a reduced staff and an increased stock due to evacuation from elsewhere. A noteworthy event has been the successful rearing of a young bird by the pair of griffon vultures; these birds have nested annually in recent years and previously hatched a chick, but they had not before succeeded in rearing it to maturity. The young bird is now fully fledged and the Society considers this a breeding record in British aviculture. The collection has received a pair of the wolves spared when the well-known pack of wolves at the Edinburgh Zoo was destroyed. The Chester Zoo is well stocked with lions and leopards, from which it is hoped to restock the depleted zoos of Europe when peace returns. The Society has just issued its monthly reports from June in a combined publication, and notes that it was the pioneer of the animal-adoption scheme later utilized with success by London, Edinburgh and Bristol: "We feel that it is in the country's interest that we should keep the Zoos alive to fulfil once again their functions when peace returns," states the Secretary.

Illuminating Engineering Society

The opening meeting for the session of the Illuminating Engineering Society was held in the Royal Institution on October 8. Prof. J. T. MacGregor-Morris, emeritus professor of electrical engineering in the University of London, the incoming president, delivered an address on "The Arc as a Standard of Light". In his opening remarks he recalled the classic experiments of Sir Humphry Davy on the electric arc, conducted at the Royal Institution shortly after 1800. It was not until 1881, however, that Captain Abney suggested that, in view of its constant temperature, the arc could be used as a standard of light. Between 1889 and 1894, Sylvanus Thomson, Mr. (now Sir James) Swinburne and M. Violle made further suggestions. To Mr. A. P. Trotter, however, and to M. A. Blondel the main credit should be given for a determined attack on this problem. In the course of this work an unexpected effect, the formation of a comma-shaped rotating spot of light at the positive crater, which Prof. MacGregor-Morris described as the "Trotter rotating comma", was encountered. This phenomenon was discussed in considerable detail. One interesting conclusion that emerges from recent researches is that, provided certain other quantities remain the same, the speed of rotation is remarkably constant. The direction of rotation can be controlled, but in general is a matter of chance. The disturbing influence of the Trotter rotating comma on the candle-power emitted by the crater was also discussed. In conclusion, Prof. MacGregor-Morris affirmed his conviction that a satisfactory high-temperature standard of light would result from the use of the three-electrode form of arc, which has recently been the subject of careful study. During the meeting, the Leon Gaster Memorial Premium was given to Mr. C. Dunbar for his paper entitled "Visual Efficiency in Coloured Light".

Science in the U.S.S.R.

An article by Prof. M. Ruhemann, "Science and the Soviet Citizen" (*Anglo-Soviet J.*, 1, No. 3, July 1940), describes the way in which the gulf between the scientific worker and the general public is being bridged in the U.S.S.R. Professional science is organized as an integral part of the planned economy of the country, and the Academy of Sciences, which supervises the planning of scientific research, advises the State Planning Committee on the extent of the country's natural resources and on the possibilities of their scientific exploitation, while it plans scientific research in conformity with the needs of the community as ascertained by the State Planning Committee. The Academy possesses scientific research laboratories of its own, but most State organizations possess their own research laboratories.

While it is not so much the work of the individual scientific worker as the general direction of scientific research that is determined by the needs of the community, every man of science, however theoretical his work may be, is rightly convinced that its final object is to serve the community. Every scientific worker is also encouraged to look out for technical possibilities arising from his work and not to rest content with publishing his results in a scientific journal. The method of recruiting men of science also encourages contact between scientific workers and the general public, while the whole educational system, as well as the use made of the Press and the influence of the trade unions, is directed to the development of a scientific attitude to life. A brief account of this aspect of education in the U.S.S.R. is contained in a further article "Preparing a Scientific Nation" by Beatrice King in the same number, while Dr. C. Norris, under the title "Experimental Medicine in the U.S.S.R.", describes some of the results achieved in medical research.

Telephone and Telegraph Statistics of the World

In *Electrical Communication* of July 1940, tables are given of the telephone and telegraph statistics of the world compiled by the American Telephone and Telegraph Company. The tables are compiled for the year ending January 1, 1939. The amount of telephone and telegraph wire in use in this period is also given. Except in the case of the United States and Canada, the telegraph service is operated by Governments. In the United States the number of miles of telephone line operated predominantly by private companies is nearly 93 million, and Canada comes next in the North American group with 5·4 million operated by private and Government concerns. In South America, the Argentine comes first with 1·58 million miles and Brazil second with 1·13 million miles, both privately worked. In Europe, Germany comes first with 18·0 million miles, and Great Britain and Northern Ireland jointly second with 15·2 million miles, both worked by Government. In Asia, Japan comes first with 4·8 million miles Government operated, and China is second with 0·8 million miles run by private companies and Government. In Africa, the Union of South Africa comes first with 0·83 million miles and Egypt is second with 0·47 million miles, and finally in Oceania Australia comes first with 2·83 million miles and New Zealand second with 0·11 million miles, all of which are operated by Government.

If we consider the percentage of telephone wire in operation possessed by the whole world, the United States possesses 53·2 per cent, Germany comes second with 10·3 per cent and Great Britain third with 8·7 per cent. Discussing the percentage of telephone line in the whole world possessed by a country per 100 of the population, it is stated that the United States comes an easy first with 71·5 per cent, Sweden is second with 49·2 and Canada third with 48·2. The total lengths of telegraph line possessed by each country run in the following order: United States 2·3 million miles, Russia 0·8 million miles and British India 0·37 million miles.

Oxford Electric Supply Undertaking

Mr. H. G. Fraser, the city electrical engineer of Oxford and manager of the electrical undertaking, can now claim for Oxford the second position among the records of the lists showing the number of units sold per head of the population relating to the authorized undertakings in Great Britain. According to the *Electrical Times* of October 3, the two main reasons why the revenue and units sold per head of the population exceeded all previous records of the undertaking were the connecting up of the heating installation of the New Bodleian Library during the early part of the summer, and the incidence of exceptionally severe weather conditions during the last quarter of the year. These two factors outweighed the general slump consequent upon the outbreak of war and the black-out. More than four million more units were sold for private lighting, heating and cooking, and this brought the total to 34 millions. This represents 563 units sold per head of the population. The surplus at £23,910 shows an improvement of £8,316.

Seismological Data from India

The *Seismological Bulletin* of the India and Ceylon seismological observatories for the period July–September 1939 has just been received. It has been published by the Government of India Meteorological Department under the direction of Dr. C. W. B. Normand. An average of eleven slight shocks and tremors daily was registered during July. It was estimated at the Colaba Observatory at Bombay that the earthquakes of July 12, 18, and 20 occurred near New Guinea, south of the Nicobar Islands and in the Pacific Ocean west of the Tonga Deep respectively. The latter probably had a depth of focus near 680 km. During August an average of ten earthquakes daily was recorded. The epicentre of the one on August 8 was in the ocean to the south-west of Ceylon, according to Colaba. It was felt over a large part of Ceylon.

The earthquake of August 25 was felt in New Guinea at Rabaul and Kokopo. During September an average of seventeen shocks was recorded, the one on September 8 being the greatest in the three months. It occurred in the Aleutian Islands though on the same day there was another shock to the south of Sumatra. According to Colaba, the shock of September 6 was in Afghanistan, and the ones of September 14, 19, 22, and 25, in the sea to the south-east of the Andaman Islands, to the south-east of Lake Aral, near Smyrna, and near the Nicobar Islands respectively. Macroseismic reports from voluntary observers mention eleven earthquakes and several tremors. The greatest of these, at Dhubri, had intensity 6 on the Rossi-Forel scale on August 21, other shocks being recorded from Drosh (3), Gauhati (2), Yatung, Tibet (2+ several tremors), Chaman and Dalhousie.

The Colombo Museum

Since Sir William Gregory in 1872 developed the idea of collecting exhibits illustrating the natural history, antiquities and industrial products of Ceylon, the Colombo Museum has preserved a high scientific standard while at the same time offering a centre of interest to the large number of people which visit its collections (334,528 in 1939). Although many influences have led to the preponderance of natural history in the Museum, the report for 1939 shows that efforts are being successfully made to build up an adequate representation of the prehistory and ethnography of the island. Much of the progress of the Museum has been due to the enthusiasm and energy of two recent directors, Dr. J. Pearson, who retired in 1932, and his successor, A. H. Malpas, who retired in 1939 and to whose skill in increasing the popular attraction of the collection and encouragement of entomological, avifaunal and ethnographical surveys the report pays a warm tribute. P. E. P. Deraniyagala has been appointed acting director and is responsible for the administration report. Its brief account of the activities of the museum staff and its considerable list of donations and other acquisitions to the various groups of collections indicate that the institution continues to strengthen its position as the conservator of Ceylon interests and a centre of scientific study.

Shrinkage of Australian Timbers

Pamphlet No. 97, 1940, of the Australian Council for Scientific and Industrial Research, written by W. L. Greenhill, is devoted to the above subject. Owing to the needs for war-time economy, photolithography instead of printing has been used in its production. The aim of the pamphlet is to give shrinkage values for the more important Australian timbers (170 kinds are dealt with). The data are presented in such a manner that they can be readily applied in industry. Sufficient information is given so that a full picture of the behaviour of the various timbers can be obtained from the point of view of shrinkage or swelling with changes of the moisture content. The correlation between shrinkage and density among different timbers is shown to be very small and is not always significant even within a single species. Data of the kind assembled in this pamphlet are an essential aid to the utilization of the timbers concerned and to their effective competition with substitutes. The testing procedure followed in determining the shrinkage values recorded in this pamphlet is essentially the same as that adopted by the American Society for Testing Materials in 1927. The specifications provide for measuring the volumetric, tangential and radial shrinkages.

Proceedings of the Royal Society of Edinburgh

Owing to the national necessity for exercising the strictest economy in paper, and in order to reduce the expense of printing and publication, the Royal Society of Edinburgh has decided that, as from vol. 61, 1940–41, the *Proceedings* shall be published in two sections, namely, "A" (Mathematical and Physical—including Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology, and Physics) and "B" (Biological—including Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, and Zoology). Fellows of the Society, and institutions with which the Society exchanges publications, will benefit under this arrangement by having, in smaller compass, papers dealing with the subjects in which they specialize. No change is proposed in the present form or in the arrangement for the distribution of the Society's *Transactions*. The obituary notices of fellows, proceedings of meetings, list of fellows, prizes, etc., formerly published as appendixes at the end of each session's volume of *Proceedings* will, under the new scheme, be published separately, and will be sent normally to all fellows and to those exchanges specially desiring to receive them.

The Night Sky in November

The moon is full on November 15 at 2·4h. U.T. and new on November 29 at 8·7h. On November 11 at 23h. Mercury is in inferior conjunction, and a transit across the sun's disk occurs. The transit is visible generally in North and South America, the Pacific Ocean and Australasia. Lunar conjunctions with the planets occur as follows: November 13d. 23h. with Jupiter; November 14d. 2h. with Saturn; November 26d. 22h. with Venus; November 27d. 3h. with Mars and November 27d. 22h. with Mercury. Three planets are in opposition during this month; on November 3, Jupiter and Saturn, their respective distances from the earth being 370 and 763 million miles. On November 16, Uranus is in opposition, its distance from the earth then being 1,725 million miles. On November 11, this distant planet will make a close approach to the 8th magnitude star B.D. +18°494. Venus is still the bright morning star rising at about 3h. at the beginning of the month and at 4h. at the end. The configurations of Jupiter's inner satellites are given in the *Nautical Almanac*, p. 628–629 and in *Whitaker's Almanack*, p. 176. Mars is now a morning star, and will pass 3° north of Spica on November 8.

Announcements

The Lord President of the Council has appointed Prof. A. V. Hill, O.B.E., Sec.R.S., M.P., Foulerton research professor of the Royal Society, Sir Felix Pole, chairman of Associated Electrical Industries, Ltd., and Sir Robert Robinson, F.R.S., Waynflete professor of chemistry in the University of Oxford, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. W. H. Mills, Prof. A. Robertson, Sir Albert Seward, and Sir Harry Shackleton have retired from the Council on completion of their terms of office.

The Crompton Medal, given for the best paper read before the senior centres of the Institution of Automobile Engineers during the session, has been awarded to Dr. J. S. Clarke, of Birmingham Corporation Gas Department, for his paper "The Use of Gas as a Fuel for Motor-Vehicles".

In 1939 there were 61,184 deaths from tuberculosis in the United States as compared with 63,677 in 1938. The death-rate dropped from 48·9 per 100,000 of population in 1938 to 46·6 in 1939. Except for Delaware, the death-rate in all States declined or remained within a decimal point higher than the 1938 figure.

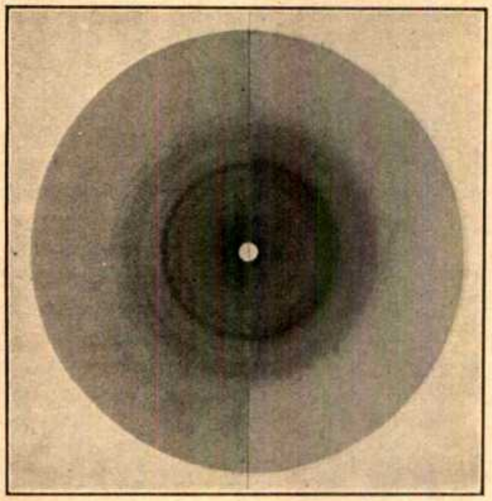
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

X-Ray Comparison of Natural and Synthetic Starch

IT has recently been described[1] how starch is synthesized *in vitro* from glucose-1-phosphate by the action of an enzyme, phosphorylase, which is present in many plants. In the light of this reaction, and of other recent enzymic and chemical data, we have undertaken a re-examination of the starch problem by X-rays. As a first step we have examined the synthetic polysaccharide formed by the action of phosphorylase from potatoes.



Natural starch gives surprisingly good X-ray powder photographs, indicating crystallites built from molecules that are probably all alike, or very nearly alike. Four principal types of photograph are known, the so-called A-, B-, C- and V-photographs, characteristic of the plant source or mode of preparation of the starch[2]. A is typified by wheat starch, B by potato starch, C is almost certainly a mixture of A and B, while V is found after precipitation by alcohol. The accompanying reproduction provides a comparison of (left) purified potato starch in the form of grains and (right) the polysaccharide synthesized by the action of potato phosphorylase on glucose-1-phosphate. The latter consisted exclusively of small grains, in which form the bulk of the synthetic product is deposited during the course of the enzymic synthesis. It will be seen that the two preparations give essentially the same pattern (B-pattern), even though that of the synthetic starch is not quite so sharp.

In certain of its properties synthetic starch shows a closer resemblance to the amylo-amylose fraction of natural starch than to normal whole starch[1]. A specimen of amylo-amylose (precipitated by alcohol after electrophoretic separation) was found to give a V-photograph, whereas a sample of the synthetic starch after precipitation by alcohol gave the B-photograph. Further investigation of the conditions governing the appearance of one or other pattern will clearly be necessary before we can hope to correlate the differences between types and fractions of starch with their X-ray patterns.

An important point for the elucidation of the starch problem by X-rays is the significance of the A-, B- and C-photographs. Are these to be traced to the existence of slightly different phosphorylases, or are they rather a function of the conditions of crystallization? There is evidence that the latter explanation is the more likely, since it is reported that the same starch may give either an A-, a B- or a C-photograph according to the temperature of deposition[3]; but the question obviously invites a study of phosphorylases prepared from a variety of plant sources.

W. T. ASTBURY.
FLORENCE O. BELL.

Textile Physics Laboratory,
University of Leeds.

CHARLES S. HANES.

Low Temperature Research Station,
Cambridge.
Sept. 18.

---

[1] Hanes, C. S., NATURE, **145**, 348 (1940); *Proc. Roy. Soc.*, B, **129**, 174 (1940).

[2] See Katz, J. R., "Die Röntgenspektrographie als Untersuchungsmethode bei hochmolekularen Substanzen usw.". (Berlin and Wien, 1934).

[3] Katz, J. R., and Derksen, J. C., *Z. phys. Chem.*, A, **165**, 228 (1933).

Anatomical Basis of Colour Vision

ONE of the criticisms commonly made in respect of the Young-Helmholtz trichromatic theory of colour vision is the lack of any anatomical evidence for the three sets of sensory receptors in the mammalian retina which are postulated by the theory, or for the three sets of optic nerve fibres which presumably connect them with the brain. It is worth while, therefore, to direct attention to the fact that there is a possible anatomical basis for the three sets of fibres.

The lateral geniculate body (that is, the centre through which the retinal impulses are projected on to the cerebral cortex) is composed of six well-defined layers of cells in man and the higher primates. Many years ago it was shown by Minkowski (on the basis of transneuronal degeneration following section of the optic nerve) that crossed retinal fibres end in layers 1, 4, and 6, and uncrossed fibres in layers 2, 3, and 5. More recently[1], these observations were confirmed and amplified by the study of the effects of small intra-ocular lesions of the retina in the monkey; in the course of this work it became apparent that the smallest retinal lesion which leads to a detectable change in the lateral geniculate body always involves a group of cells (of approximately equivalent size) in *all* the corresponding three layers, these cells being disposed as a straight band radiating from the hilum of the geniculate body to its convex surface. In other words, it appears that the *receptive unit* of the lateral geniculate body with respect to each retina is a narrow band of cells radiating from the hilum and involving either the cell-laminæ 1, 4, and 6 (heterolateral fibres) or 2, 3, and 5 (homolateral fibres).

From this observation it may be inferred *either*: (1) that each single retinal fibre on arrival at the lateral geniculate body divides into three terminals, each passing to one of the three corresponding cell-laminæ, *or* (2) that the conducting unit in each optic nerve in relation to the lateral geniculate body consists of three fibres arising from adjacent ganglion cells of the retina, and that of these three fibres (in the case, for example, of crossed fibres), one terminates in cell-lamina 1, a second in lamina 4, and a third in lamina 6. It may be said at once that there is no neurohistological evidence for the first alternative, and that the second, therefore, is more probably correct.

But the Young-Helmholtz theory also postulates that the conducting unit of the optic nerve (so far as colour vision is concerned) should consist of three fibres, related respectively to the sensations of red, green and violet. Hence it may be said that our experimental studies of the lateral geniculate body provide quite definite anatomical support for the theory.

Until further direct evidence is available, of course, the implication that each set of three cell-layers in the lateral geniculate body is related to the fact that normal colour vision is trichromatic can only be regarded as an interesting speculation. It is not impossible that the histological study of the lateral geniculate body of colour-blind individuals might lead to definite results, but such specimens are naturally hard to come by. There are, however, two other points regarding the normal geniculate body which are apposite to the problem. One of these is that the fully developed six-layer formation is only found in the primates, and the primates are the only mammals so far known by properly controlled testing to have full colour vision. The other point is that, in the monkey (and also in man), the full development of the six layers is only found in that part of the nucleus concerned with central vision. In the rostral portion and the lateral and medial borders of the caudal two thirds, the six laminæ merge with each other to a considerable extent, and these regions are concerned with extreme peripheral vision where the recognition of colour distinction, of course, is not possible.

W. E. Le Gros Clark.

Department of Human Anatomy,
University Museum,
Oxford.
Oct. 4.

---

[1] Le Gros Clark, W. E., and Penman, G. G., *Proc. Roy. Soc.*, B, **114**, 129 (1934).

---

l-Galactose as a Component of a Polysaccharide of Animal Origin

In the course of a study of the products obtained by the methanolysis of methylated galactogen, the parent polysaccharide having been prepared from the albumin glands of *Helix pomatia*, we obtained by distillation in a high vacuum certain fractions the properties of which indicated that they consisted wholly of pentamethyl hexose, apparently 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactoside. One of us[1] has recently investigated the $n_D^{16^\circ}/[\alpha]_D$ (in water) relationship of mixtures of the α- and β-forms of this galactoside; on making use of these observations, it was found that the $[\alpha]_D$ values of our fractions were much smaller than was to be expected from the observed $n_D^{16^\circ}$ values. Thus in one fraction showing $n_D^{16^\circ}$ 1·4494, the $[\alpha]_D$ was found to be +55·6° as against the expected value of +118°. This suggested that the fraction in question must have contained only about 75 per cent of 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactosides, together with 25 per cent of the corresponding derivatives of *l*-galactose: no sugars other than *d*- and *l*-galactoses appeared to be present from consideration of the yields of mucic acid produced on oxidation of the galactogen by nitric acid.

Careful fractionation of the products obtained by splitting methylated galactogen with methyl-alcoholic hydrogen chloride indicated that the original polysaccharide contained a total number of galactose units equal to seven, or a multiple of seven, and that of these one in every seven arises from *l*-galactose, the others being derived from the *d*-isomer. The same conclusion was reached from considerations of the final $[\alpha]_D$ observed in acid hydrolysates of galactogen itself. If the latter consisted wholly of condensed residues of *d*-galactose, a final $[\alpha]_D$ value of +80·5° (calc. on sugar present) would be anticipated, but May[2] had already reported that a value of only +53·6° is attained. He explained the discrepancy by supposing that he had to deal with "β-*d*-galactose" ($[\alpha]_D = +53^\circ$), stabilized in some manner hitherto unknown. Some time ago[3], we carefully repeated May's experiment and found a final value of +56·5°, which agrees closely with that of +57·5° which can be calculated for an equilibrated mixture of six parts of *d*-galactose with one of the *l*-isomer.

l-Galactose, usually accompanied by the *d*-isomer, has been detected in a few biological materials of plant origin. Thus it has been obtained from Chagual gum[4], from the Japanese drug Nori[5], from quince gum[6], from flax-seed mucilage[7] and from agar[8]. So far as we are aware, however, this is the first instance in which the presence of *l*-galactose has been suspected in a material of animal origin. We therefore took steps to isolate from acid hydrolysates of galactogen a characteristic derivative of this uncommon sugar.

After neutralizing the acid and isolating the combined sugars, a quantity of crystalline *d*-galactose was isolated by fractional crystallization from 90 per cent alcohol. The residual solution was then decolourized with charcoal and evaporated to dryness, the residue being dissolved in boiling 97 per cent alcohol, from which a syrup separated on cooling. This was rejected and the material remaining in the mother liquors was recovered by evaporating the solvent. From this residue, and from *dl*-galactose, we prepared crystalline benzimidazole derivatives by the method of Moore and Link[9]. The two products had the same characteristic crystalline form and melting point (233°, separately or mixed) and both were optically inactive. Analysis of the specimens of *dl*-galacto-2-benzimidazole provided confirmation of their identity :

		% C	% H	% N
Product from galactogen	..	53·3	6·4	10·0
Product from *dl*-galactose	..	53·5	6·3	10·4
Calculated for $C_{12}H_{16}O_5N_2$	..	53·7	5·97	10·4

This work will be described in more detail in a forthcoming paper.

Biochemical Laboratory,
Cambridge.

David James Bell.
Ernest Baldwin.

---

[1] Bell, *J. Chem. Soc.*, in the Press (1940).

[2] May, *Z. Biol.*, 95, 277 (1934).

[3] Baldwin and Bell, *J. Chem. Soc.*, 1461 (1938).

[4] Winterstein, *Ber.*, 31, 1571 (1898).

[5] Oshima and Tollens, *Ber.*, 34, 1422 (1901).

[6] v. Lippmann, *Ber.*, 55, 3038 (1922).

[7] Anderson, *J. Biol. Chem.*, 100, 249 (1933).

[8] Pirie, *Biochem. J.*, 30, 369 (1936).

[9] Moore and Link, *J. Biol. Chem.*, 133, 293 (1940).

Hydration of Substituted Amides of Stearic Acid

Previous work[1,2] has indicated that in hydrated stearanilide the bound water is held by a micellar structure. It has also been shown[1] that a chain containing at least sixteen carbon atoms is necessary for water-binding by anilides of normal fatty acids. Further investigation of factors influencing hydration has now been made.

5-gm. samples of derivatives of stearanilide were hydrated and examined in the manner already described[1]. In the accompanying table are recorded the percentages of bound water in a selection of hydrated compounds.

Hydrated compound	Percentage water	Hydrated compound	Percentage water
Stearanilide	88·5	*o*-Carboxy-stearanilide	21·6
Stear-*o*-toluidide	86·3	*m*-Carboxy-stearanilide	70·8
Stear-*m*-toluidide	71·8	*p*-Carboxy-stearanilide	53·4
Stear-*p*-toluidide	85·3	Stear-diphenylamide	0·7
Stear-methylanilide	0·3	Stear-α-naphthylamide	77·4
Stear-*o*-nitranilide	80·0	Stear-β-naphthylamide	84·9
Stear-*m*-nitranilide	80·8	Stear-phenylhydrazide	71·7
Stear-*p*-nitranilide	87·5	Stearamide	85·5
p-Bromo-stearanilide	81·4	Stearic acid	72·5

A study of these results shows that with certain notable exceptions all the compounds examined are capable of binding large quantities of water. Evidently the introduction of substituents into the nucleus of stearanilide has little effect on water-binding capacity, though a carboxyl group in the *o*- or *p*-position reduces the amount of water bound. Replacement of the remaining hydrogen atom of the amino group, however, effectively prevents hydration, as is shown by the fact that both stear-methylanilide and stear-diphenylamide are incapable of taking up water.

An explanation of this may be based on the assumption that the formation of a micellar structure and the binding of water by it are consequences of enolization resulting in the transformation of the -CO-NH- grouping to -C(OH)-N-. The fundamental importance of enolization is deduced from the fact that both stearamide and stearic acid become heavily hydrated and hence neither the benzene nucleus nor the nitrogen atom can be primarily responsible for the binding of water. It seems not unreasonable to suppose that the micellar structure formed has the character of a fibrillar meshwork, or felt, in the interstices of which water becomes entrapped. The bulk of the water is probably located around the -C(OH)- groups, and its presence, coupled with attractive forces between these groups in neighbouring molecules, may be largely responsible for the construction and stability of the felt. The influence of the solvent (alcohol) cannot, however, be ignored and this aspect of the problem is now being studied.

Department of Chemistry,
The Queen's University,
Belfast. Sept. 12.

B. A. Toms.

---

[1] Nature, 145, 1019 (1940).

[2] Nature, 146, 266 (1940).

A Cambridge Pleistocene Climate

Mr. T. T. Paterson's demonstration of the 'frost cracks' in the Travellers' Rest pit at Cambridge[1] affords a valuable clue to a Pleistocene climate of that region. The presence of permanently frozen ground in England within Pleistocene times has been suspected, but proof has been wanting. 'Frost cracks' in active formation are occupied by wedges of ice and they can only attain a considerable width in ground which remains frozen for many years. E. de K. Leffingwell considered the ice wedges in cracks in northern Alaska to have grown by successive annual increments of a few millimetres and he estimated that the wedges, which are up to three metres across, had taken 500–1,000 years to form[2]. Some of the Travellers' Rest fissures are nearly two metres across and they indicate a prolonged period of low temperatures.

G. Holmsen's finding that ground ice may occur where the mean annual temperature is 25° F. or lower is generally accepted[3], and from an examination of the distribution of the permanently frozen ground in Northern Canada, W. A. Johnston concludes that it is likely to occur where the mean annual temperature is "say 26° F. or lower"[4]. The present (1906–35) mean temperature of Cambridge is 49·3° F. 'Frost cracking' cannot take place beneath any considerable snow cover and the precipitation must have been low. At present (1885–1915) the annual precipitation is 21·82 inches, ground frosts occur on 112 days, and snow lies in the morning on only 12 days in the year[5].

Mr. Paterson's evidence proves the soundness of the conclusions reached by C. Reid more than fifty years ago from a study of the character of the cold fauna and flora of the Pleistocene period, that the mean temperature in the south of England was considerably below the freezing point ("probably about 30° lower than now") and "consequently all rocks not protected by snow would be permanently frozen"[6].

L. Hawkes.

Bedford College for Women
at "Springfield",
Sidgwick Avenue,
Cambridge.
Oct. 4.

---

[1] *Quart. J. Geol. Soc.*, 96, 99 (1940).

[2] U.S. Geol. Surv. Prof. Paper, 109, 211 (1919).

[3] *Norsk. Geog. Selsk. Aarbok*, 24, 131 (1912–13).

[4] *Trans. Roy. Soc. Canada*, Sec. 4, 24, 39 (1930).

[5] "The Cambridge Region", Camb. Univ.-Press (1938).

[6] *Quart. J. Geol. Soc.*, 43, 369 (1887).

RESEARCH ITEMS

Storage of Chemical Activator by Body Lipoids

A paper on "Fats and Oils as Protective Repositories of Neurohumors and other Chemical Activators" was read by G. H. Parker, of Harvard University, at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The colour changes in catfish are controlled by three chief neurohumours, intermedin from the pituitary gland, acetylcholine and a concentrating neurohumour (probably adrenaline) from the dispersing and the concentrating nerve-fibres respectively. Of these three, the two from the nerves, acetylcholine and adrenaline, are soluble in fats and oils. Acetylcholine induces a dispersion of melanophore pigment and consequently a darkening of the fish. Adrenaline, on the other hand, concentrates this pigment and blanches the fish. When acetylcholine has been discharged for some time from the dispersing nerves, it accumulates in the fatty or lipoid constituents of the tissues about the melanophores, and in consequence continues the dispersion of pigment for some time after the dispersing nerves have ceased to act. It can be extracted in measurable amounts from dark fish skins. It escapes destruction by choline esterase by its retreat into fatty materials, where it is temporarily stored. The same appears to be true of adrenaline, another important general nerve activator. Thus the fatty or lipoid substances in the animal body may serve as storage reservoirs for agents that may be of first consequence in the animal economy. This storage activity of lipoids for important activating agents has not received the attention of biologists that it probably deserves.

Fossil Birds of North America

In 1931 the American Ornithologists' Union included a list of fossil forms in its Check-list of North American Birds. The past nine years, however, had made many additions and some changes, and in order that these, recorded in many scattered papers, should be brought together, Alexander Wetmore has compiled a new "Check-list of the Fossil Birds of North America" (*Smithsonian Misc. Coll.*, 99, No. 4; June 1940). The list runs to 81 pages, and includes 184 species of birds now extinct, including the New World toothed birds (Odontognathæ) made famous by the researches of Marsh. In addition, there are included 165 species of birds which are still living, but the remains of which have been found in Pleistocene deposits, generally in caves and in the rich fossiliferous beds of the asphalt lake of Rancho La Brea.

Barnacles attached to Birds

A note by Granville Ashcraft records the curious occurrence of barnacles growing upon the breast feathers of living birds (*Condor*, 42, 218; 1940). Two Pacific fulmars, *Fulmarus glacialis rodgersii*, were shot on the wing while they circled the Allan Hancock Foundation cruiser dredging for marine life off San Francisco Bay, California. Several dozen clusters, each containing three or four individuals of young stalked barnacles, *Lepas hillii*, were found to be attached to the barbs of the belly feathers. The occurrence illustrates the mass settling of barnacle larvæ, which must have taken place when the fulmars were persistently roosting upon the water, and since this species of barnacle is not tolerant of conditions of drought, it indicates that during the period when the barnacles were growing the birds must have been on the ocean most of the time. The largest had a capitulum 3·0 mm. long and a stalk of 1·1 mm. So long ago as 1874 Targioni-Tozzetti proposed a new generic name (Ornitholepas) for barnacles growing upon the tail feathers of *Priofinus cinereus*, but later workers regarded the specimens as only a larval cirripede in its cypris stage.

Graptolites of Australia

Australia has taken a considerable share in developing the knowledge of graptolites and their value as indicators in the interpretation of stratigraphical zones, since Frederick McCoy was appointed palæontologist to the Geological Survey in 1856. But much of the early work has been overlooked, and R. A. Keble and Prof. W. N. Benson have done good service in recording the full bibliography and the history of research on Australian graptolites (*Mem. Nat. Mus. Melbourne*, No. 11, 11–99; 1939). Titles of 159 papers bearing on Australian forms are listed, and the progress of research is discussed in three periods: the first period, 1856–1892, was a preliminary period of recording and correlation with the European and American faunas; the second, 1892–1932, introduced more detailed zoning and the recognition of an Australian stratigraphical sequence; the third, 1932 to the present, is the period of revision and systematization. The fauna, the history of the discovery of which is summarized by the authors, is probably the most complete graptolite fauna in the world, certainly in regard to its Ordovician components, and it is remarkable that so great a similarity exists in the Upper Ordovician of Australia and of Great Britain that "with further work it may even be possible to adopt the English classification".

Hereditary Nose-Bleeding

Recurrent nose-bleeding is inherited as a Mendelian dominant in a family of the United States. H. K. Fink (*J. Hered.*, 31, 319–322; 1940) gives a pedigree involving six generations in which the affected individuals developed heavy nose-bleeding from about the time of puberty. It has been found that diet involving calcium lactate considerably alleviates the amount and frequency of bleeding.

Linkage in the Human Sex Chromosome

T. White (*J. Genetics*, 40, 403–437; 1940) reports a pedigree involving seven generations which exhibits congenital stationary night-blindness, myopia and deuteronopia. The pedigree indicates that these defects were all on one X-chromosome, but have on several occasions crossed over in a female. In an appendix, J. B. S. Haldane discusses the calculation of the cross-over percentage between the genes involved.

Sodium Polyiodides

As is well known, iodine is much more soluble in solutions of alkali iodides than in pure water, and this is the result of the formation of polyiodides, for example, KI_3, in solution. Many of these polyiodides have been isolated in the solid form, many being anhydrous, but the potassium compounds are known only as hydrates, KI_3, H_2O and KI_7, H_2O. G. H. Cheesman, D. R. Duncan and I. W. H. Harris (*J. Chem. Soc.*, 837 ; 1940) in a phase-rule study of the system $NaI-I_2-H_2O$ at 0° conclude that the compounds NaI_4, $2H_2O$ and (possibly) NaI_2, $3H_2O$ are stable at that temperature. The di-iodide (which may be NaI, NaI_3, $6H_2O$) is the first example described of a polyiodide of this type. The numbers of iodine atoms combined with one atom of sodium are both even, whereas in the potassium system the numbers are odd. Even polyiodides (for example, CsI_4, $2KBr_6$, $3H_2O$ and possibly $CsBr_4$), however, have been previously reported. The alternative formulation NaI, NaI_3, $6H_2O$, it is pointed out, would agree better with the physico-chemical evidence for a dissociated tri-iodide ion in solutions : $I'_3 \rightleftarrows I_2 + I'$, higher polyiodide ions being formed when the proportion of iodine is high.

Synthesis of Radioactive Lactic Acid

G. B. Kistiakowsky and Richard Cramer, of Harvard University, described this work at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. Lactic acid containing the C^{11} isotope in the carboxylic position was synthesized from carbon oxides produced by the bombardment of boron oxide by deuterons in the Harvard cyclotron. The oxides were converted to carbon dioxide and thence to potassium cyanide ; this combined with acetaldehyde in alkaline solution to give a α-hydroxy-propionitrile which was hydrolysed by hydrochloric acid to lactic acid. The mixture was made alkaline again, evaporated to dryness and extracted with acidic dry ether to eliminate inorganic materials. The ether phase was then extracted with water to separate lactic acid from polymerized acetaldehyde and concentrated to about 2 c.c. volume containing some 50 mgm. of lactic acid, to which 100 mgm. of ordinary *d-l* lactic acid were added when needed. The entire synthesis took approximately 1½ hr., the yield of C^{11}, allowing for radioactive decay, being about 30 per cent. The residual radioactivity was sufficiently strong to follow it for approximately five hours, and thus the acid could be used in biological experiments.

Crystallization Curves of Solid Solutions

N. L. BOWEN, of the University of Chicago, presented a paper on "Nodal Points on Crystallization Curves of Solid Solutions" at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The crystallization curves in solid solution systems characterized by a valley curve (Tallinie) on the fusion surface have been treated by Schreinemakers for the case of crystallization with perfect fractionation. He did not examine the case of crystallization curves with perfect equilibrium; but other investigators have done so, and they agree that the curves of perfect equilibrium crystallization have points of inflexion where they intersect the valley curve. On the other hand, there is no agreement among them as to the manner of location of the point of intersection with the valley curve. This confused condition suggested a new analysis of the problem, which shows that the point of intersection of valley curve and crystallization curve is determined by a simple construction, that a crystallization curve has no unique properties at this point, that some crystallization curves have nodal points but the locus of nodes is a curve which is independent of the valley curve.

A New Conduction of Heat Phenomenon

G. W. STEWART, of the State University of Iowa, presented a paper under this title at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. It is currently accepted that the transfer of energy in the conduction of heat in solids and liquids occurs by means of acoustic waves. In solids these consist of longitudinal elastic waves. In liquids it has recently been argued by Lucas that the more important carriers are transverse waves of viscosity and inertia. A new phenomenon in heat conduction has been found which is most easily interpreted by the presence of these transvorse waves of viscosity and inertia. If the molecular swarms in liquid crystalline *para*-azoxyanisol are studied by means of X-ray diffraction, facts may be obtained concerning the orientation of these elongated swarms under the application of either the magnetic field or heat conduction. It is demonstrated that the swarms are oriented by the conduction of heat, their long axes perpendicular to the direction of the conduction. This phenomenon has been established by two experimenters, Holland and Reynolds, with different apparatus and methods. The orientation of the swarms corresponds to the effect of a cross-convection current. The transverse waves of Lucas may produce this result. These experiments demonstrate a new phenomenon and also add credence to the importance of the transverse waves of viscosity and inertia.

Corrosion Resistant Alloys

H. H. Uhlig and John Wulff, of the Massachusetts Institute of Technology, discussed this subject in a paper before the annual meeting during April 22–23 of the U.S. National Academy of Sciences. Various solid solution alloys of the transition and pre-transition group elements have wide application due to their corrosion resistance. This is attributed to their passivity, which is usually explained on the basis of an impervious oxide film. Electrochemical, threshold potential and corrosion data are not explained in simple terms on this point of view. A consideration of such data for iron-chromium, iron-nickel and copper-nickel alloys shows that corrosion resistance begins at critical alloy compositions ; thus, atomic ratios of five Fe atoms to one Cr, or two Fe to one Ni are sufficient to induce passivity. This may be attributed to the ability of Cr in the Fe-Cr system to provide sharing possibilities for five electrons of the five nearest Fe neighbours, based on the assumption that Fe with one shared electron is passive. The solution of hydrogen in the surface lattice destroys passivity, the hydrogen electrons displacing Fe-Cr bonds. Chemo-sorption of oxygen may enhance the passive nature of boundary alloy compositions as well as pure metals by electron sharing similar to Cr. The present electron sharing point of view harmonizes many of the divergent theories concerning the passivity of pure metals and provides plausible explanation for the corrosion resistant alloys of the transition elements.

DIRECTIONAL STABILITY OF SHIPS

THE two qualities which jointly may be said to constitute the steering performance of a ship are its manœuvrability and its course-keeping ability. In experimental work and full-scale trials, attention has usually been directed to the first of these.

It is recognized that the two are to some extent opposed. A vessel which answers the helm readily is likely to show a greater tendency to yaw from a straight course, even when no rudder is applied, than one which is less easily manœuvred. The relative importance of the two qualities depends on the service for which the ship is designed. Coasters and cross-channel boats require greater facility in handling than ocean-going ships which spend most of their time at sea and do not have to enter small harbours without the assistance of tugs. The lack of directional stability tends to increase the extent to which the rudder must be used to maintain a steady course, and this is known to influence the horse-power required and hence the fuel consumption for a given average speed. When automatic steering is employed, the stabilizing effect of the gyro-pilot must be sufficient to overcome any inherent lack of directional stability in the ship itself. Quantitative prediction of the vessel's properties in this respect requires experimental work on the course-keeping of the model hull.

In *Engineering* of October 4, Dr. Lockwood Taylor discusses the methods by which such tests can be carried out in practice. It is not usually feasible to give positive directional stability to any ordinary ship of normal form, in the sense that an aircraft having sufficient rear-fin area has it. In the case of a ship, the form-factors involved are principally the profile of the forefoot and the extent of the after deadwood. But as the amount of latitude in fixing these is restricted by resistance, docking and structural considerations, any slight accidental yaw that the ship may acquire tends to accentuate itself. It is difficult to make any direct measure of this with accuracy. Resort is therefore had to an indirect method involving a special technique.

The direct method is to tow the model in the ordinary way and, when a steady speed has been reached, to release it from the guides which normally prevent yawing and to record the free motion which results. An indirect measure of what the author terms the static directional stability can be got by a method suggested by aeronautical practice in wind-tunnel tests on the longitudinal stabilities of aeroplanes. The model is towed at a small fixed angle of yaw, and the corresponding ship-turning moment about amidships is measured. The greater the unstable yawing moment at a given angle, the more rapid the rate of development of a swing under free conditions.

To obtain information about the dynamic or damping moment, it is necessary to use a method in which actual swinging of the model occurs. To control the motion and render it stable and oscillatory, a torsion spring of sufficient stiffness more than to balance the unstable hydrodynamic moment is fitted at the pivoting point. The constrained model has then a definite yawing period, from which, in conjunction with the known strength of the spring, the desired information as to the variation of yawing moment with angular position can be deduced. The records obtained from the oscillation of the spring-controlled model give after analysis the hydrodynamic damping.

PHYSICAL CONTROLS IN ADJUSTMENTS OF THE EARTH'S CRUST

DR. NORMAN L. BOWEN, professor of petrology at the University of Chicago, speaking on internal movements in the earth at the Bicentennial Conference of the University of Pennsylvania on September 19, pointed out that because man's activities are limited to the surface of the earth and to a short distance above and below the surface, his knowledge of the structure of the great interior bulk of the planet has necessarily been derived from such indirect evidence as the behaviour of earthquake waves passing through it. It is not surprising, therefore, that differences of opinion exist among geologists as to how the continents, oceans and mountains were formed. But upon one thing all are agreed. The earth is not and probably never has been a solid, unyielding block of material. Beneath the crust there is considerable mobility, usually slow and ponderous, to be sure, but movement nevertheless; and the mobility, all geologists are agreed, is dependent upon a gradient of temperature.

Major deformation of the earth's crust has been referred to four different types of action: (*a*) contraction of the earth as a result of cooling; (*b*) invasion of liquid magma; (*c*) interior convection currents and (*d*) migration of continents. There is the greatest diversity of opinion as to which of these actions accounts most satisfactorily for the major surface features of the earth, but whatever may be the truth, it is certain that each of them is either caused or controlled by the earth's temperature gradient.

Dr. Bowen pointed out that thermal shrinking of the earth could occur only if the earth was losing heat. Upward invasion by magma (molten rock) can only occur if there is, below the cold exterior, material at sufficiently high temperature to permit flow toward the surface and extrusion upon the surface. Convection currents can occur only if there is a temperature gradient, with hot mobile material lying below colder material. Migration of continents can only take place if there are, beneath the rigid continental masses, materials of sufficient mobility to permit sliding.

The earth's internal temperature is suggested by the high heat (1,150°) of basaltic lavas thrown out by volcanoes, and also by measurements in bore holes. But the deepest holes have penetrated considerably less than two miles of the earth's crust, and this is such an insignificant proportion of the radius of the earth (which is 4,000 miles) that it gives only a very insecure basis for the estimation of deep temperatures.

Conflicting with the theory that the sub-crustal material is fluid (which seems necessary to account for the mobility) is the fact that it behaves towards tidal forces as would a highly rigid body. Its free transmission of earthquake waves also suggests a solid earth.

Dr. Bowen outlined efforts which have been made to reconcile these conditions. One suggestion is that the interior liquid is subject to such high pressure that it exhibits characteristics of rigidity toward forces of short duration, but 'gives' as a thick fluid under the stress of long-continued forces. Another view is that the earth is entirely crystalline, but shows mobility by granular readjustment, accomplished partly by elastic effects and partly by recrystallization.

Dr. R. A. Daly, of Harvard, has proposed the theory that beneath the crust there is a shell of glassy basalt, above its melting temperature but held in an almost solid state by this intense pressure. When the pressure is released at any point the basalt becomes a thin fluid and erupts.

Dr. Bowen's own theory involves what is termed 'selective fusion'. He believes that the basalt is a crystalline layer held under pressure near but above its crystallization temperature. As the pressure is relieved those ingredients of the rock layer which have the lowest melting point become fluid, carrying in suspension those ingredients which have a higher melting point and which are, therefore, still in crystalline form.

PERIODICITIES IN SOLAR VARIATION REFLECTED IN WEATHER

DR. CHARLES GREELEY ABBOT, secretary of the Smithsonian Institution, in a paper at the Bicentennial Conference of the University of Pennsylvania on September 17, stated that he has found periodicities in solar variations, which range in length from 8 months to 273 months, that have continued without change of phase for at least a century. The variations under discussion do not include those short-interval sequences of rise and fall in solar variation which cover but a few days each and which govern weather changes for the subsequent two or three weeks. While these are important, he dealt with the longer cycles which have more pronounced effects on temperature and rainfall and which "through these agencies influence production, prices, and social concerns of major interest".

Observations have been made by Dr. Abbot and collaborators at stations on mountains in desert regions all over the world, where the strength of the sun's radiation can be measured with the least possible interference from local atmospheric conditions. He now has a series of measurements covering most of the days of each year since 1920, and the study of these indicates that the sun's radiation changes within the range of 0·5–1 per cent in cycles of the following lengths :

8 months	39½ months
9¾ "	45¼ "
11¼ "	68 "
21 "	91 "
24·9 "	137 "
273 months	

The least common multiple of these periods is 273 months, which is approximately twice the length of the sunspot period of 11⅜ years ; it may be noted that the late Prof. G. E. Hale showed that magnetism in the sunspots has a period of two sunspot cycles.

Dr. Abbot, although his daily solar observations at the Smithsonian have been carried on for only twenty years, has been able to project these cycles back through occasional solar observations made since 1905 by the Smithsonian observers at Mt. Wilson, California, and through earlier ones made in New Haven, Copenhagen and Berlin. Thus his periodicity scheme has been checked through intervals covering more than a century.

In addition to the periods mentioned, Dr. Abbot has noted sequences of approximately 46 to 92 years which have had profound effects on precipitation, as noted, for example, by the level of Lake Huron. During the ten years following 1837 it fell 5 ft. Forty-eight years later Lake Huron began a similar, but not quite so great, ten-year fall, and then in 1929, or 92 years after the first recorded fall, there occurred another which almost exactly duplicated that of 1837. These 46- and 92-year cycles, he explained, are made up of two and four double sunspot cycles, each double sunspot cycle being 23 years.

"Although achieving moderate success in long-range forecasting by using the 23-year period and its multiples," said Dr. Abbot, "I have long hoped to get greater accuracy by building up forecasts from the effects of the individual solar periods." But the complexity of the earth and its atmosphere made this very difficult, he said, adding that "indeed the meteorologists have practically given up the use of periodicities because of unpredictable changes of phase in weather phenomenon."

But last December it occurred to Dr. Abbot that the changes of phase in weather might be caused by changes in season of the year, which, of course, are not dependent upon the sun itself but upon the movement of the earth around the sun. Since our 12-month year does not coincide exactly with any of the solar radiation cycles, obviously a point in a solar cycle does not fall on the same date every year.

"For instance," said Dr. Abbot, "if we are dealing with the 11¼ month period, its solar cause, if unchanging in phase, will gradually march in phase through all the months of the year. Only once in 15 years will it recur in the same relationship to the months of the year, that is, on the same date. May it not reasonably be that its effect on weather may be different in January, when the northern hemisphere is blanketed with snow, and the atmospheric circulation is vigorous, from what its effect would be in the very different conditions prevailing in July ?"

Dr. Abbot tested this on nine stations scattered from Alaska to South Africa and is satisfied that the changes of solar radiation can be correlated with weather changes here on earth. Since each of the solar periodicities, whatever its length, has a certain least common multiple with respect to our 12-month year, it is possible to compute dates which occur at intervals of a certain number of years and upon which the weather effect of the given solar period should recur. The 8-month period recurs in the same phase every two years, since 24 months is a common multiple of 12 and 8.

As examples of long-range forecasting based upon these periods, Dr. Abbot said that he got a 71 per cent correlation on predicting the weather in Peoria, Illinois, for five years ahead, beginning in 1935. This, the best result thus far in a number of 5-year forecasts made for various stations, covers mean monthly values of the departures from normal precipitation. Two years ago, Dr. Abbot, at the request of Vice-President Garner, made a prediction of the precipitation for San Antonio, Texas, on the basis of the 23-year sunspot cycle, and very good results were achieved.

ELECTRICITY PROBLEMS IN GERMANY

It will have been noticed that the targets aimed at very frequently by the R.A.F. in Germany are electrical power stations. Two reasons for this are mentioned in an article in the *Electrician* of October 4. The first is that German industrial production, more than any other in Europe, depends on electricity, and the second that there is a great shortage of electricity due to the enormously increased demands for war production and to the exhaustion of reserves.

A few figures given demonstrate the problem which besets this part of Germany's war industry. In the year 1933, which witnessed the inception of the Nazi economy, the production of electricity was about 25,000 million kilowatt hours. Since then it has risen steadily to 36,000 million in 1935, 48,000 million in 1937, and finally 55,000 million in 1938. In 1939 still greater quantities were required, and it is unlikely that in 1940 the demand for electricity will decline. Two years ago, German experts pointed out that, owing to the special requirements for the production of substitutes and *Ersatz* articles, a consumption of some 100,000 million kwh. could be expected by 1943. This is twice as much as in 1938 and four times as much as in 1933.

As yet, no way has been found to meet these requirements. German experts themselves have left no room for doubt that the peak of production, determined by the availability of the plant, etc., has already long been reached. While the consumption of electricity increased twofold between 1933 and 1938, the productive capacity of electricity works increased only by about 12 per cent. This disproportion did not constitute a serious problem so long as there were enough reserves provided for in most of the gigantic electricity plants, built in Germany since 1918 with British and American capital. According to official statements dating as far back as the end of 1938, these reserves do not exist any longer. A report of the Reich commissioner of the power industry, who early last year was appointed by Goering to increase the production of electric power, disclosed that it was difficult to cover the industrial peak requirements for electricity in the winter of 1937–38. Since that time the problem has become more acute.

The reason for this shortage lies to a considerable extent in the increase in the production of synthetic materials, which require disproportionately large quantities of electricity. One single industrial undertaking producing such synthetic substances requires an electricity plant of some 100,000 kilowatts. From the following figures published at a meeting of the Association of Electrical Engineers in 1938, it is seen that the production of, for example, 1 ton of iron requires 100–200 kwh. ; copper, 300 kwh. ; synthetic rubber, 40,000 kwh. ; synthetic petrol, 3,000 kwh. ; textiles, 3,800 kwh. ; artificial silk, 7,000 kwh. ; aluminium, 20,000 kwh. ; and magnesium, 44,000 kwh.

Figures concerning the aluminium industry in Germany indicate that, so early as 1938, this branch produced 180,000 tons (which output is still far from satisfying Germany's war demands). The figure for magnesium was 100,000 tons, and the same quantity of synthetic rubber was also made. These substances, with synthetic petrol, which form only a part of the whole German *Ersatz* industry, require 20,000 million kwh., or two fifths of the whole 1938 consumption of power. This indicates to what extent German war production relies on electricity, and how a shortage or an interruption of electricity production is bound to hamper output.

Official estimates show that new plants of some 10 million kilowatts capacity have had to be built within a short period to meet these growing requirements. Construction on such a large scale has cost not only some 3,000–4,000 million Reichsmark, but also, a more important item, a great expenditure of time. One electricity plant cannot, in present circumstances, be constructed in less than four or five years, owing to the difficulties in the building industry and in the production of the required equipment. The shortage of skilled labour will increase these problems. The erection of power works which rely on water-power instead of steam would take still more time. For example, five years have been provided for the construction of only one part of the new electricity plant in the Tavern district of Austria which was planned shortly before the War.

Five sixths of the electricity works in Germany depend on coal, while only one sixth is water driven. Exports of British coal amounting to 20 million tons annually have now been completely stopped. Germany's iron industry alone will soon require a 30 per cent increase in coal, owing to the use of low-grade iron ores.

PROBLEMS ARISING FROM AN AGEING POPULATION*

By Dr. L. J. Dublin

AGEING of the American population—a result of a lengthening average life span and a declining birth-rate—is due to create serious social and economic problems for the future generations.

If we insist on lightening the burdens on ourselves by reducing the number of our children, we must be prepared to accept the consequences in terms of our social economy. We must be aware of the condition of life we are imposing on our children—namely, an obligation to care for a huge proportion of old people.

Since the beginning of the century, the birth-rate in the United States has decreased by more than one third. Immigration has been drastically cut, and during several recent years more people left the country than entered it. The mortality in the childhood ages is only a fifth of what it was three decades ago. It is these three factors which have shifted the population from youth towards the older ages. In 1850 there were 3,080,000 people in the United States who were sixty-five years of age or older, or 4·1 per cent of the population. To-day the figure is 8,418,000 or 6·3 per cent, and in 1980 it is expected to be 22,000,000, or 14·4 per cent.

In 1980, the birth-rate and death-rate are expected to meet—13 births and 13 deaths per 1,000 population—and thereafter the death-rate will be greater than the birth-rate, resulting in a declining population.

The bright side of the picture is in the improvement in death-rate. A century ago a little less than half the babies born in England and Wales were expected to reach the age of fifty. The situation was probably about the same in the United States. In 1938 four out of five male infants and five out of six female babies were expected to reach fifty. The chances of a new-born child reaching age sixty-five are to-day as great as the chances of reaching fifty were only thirty years ago, or about four out of five among white males and two out of three among white females. The continued improvements should ultimately enable three-quarters of the infants born to reach sixty-five.

A recent re-count of a group of persons born about 1876 shows that 20 per cent more lived to the age of fifty than were expected to at the time of their birth, which reflects improvement in medicine and in welfare conditions made during their lifetime; 30 per cent of those who to-day are sixty-five or older owe their survival to improvements of this kind made since they were born.

The improvements which have made this greater survival possible are reflected in the changed line-up of the leading causes of death, with tuberculosis, first in 1900, now reduced to seventh, and heart disease (an affliction mainly of the middle-aged and elderly) fourth in 1900, now elevated to first place. Cancer was the eighth ranking cause of death in 1900 and now it is second. Violence was sixth at the turn of the century and it is now third.

All this means that medical men will have an increasing number of heart and cancer patients and that measures must be intensified to hold these diseases in check. The number of blind and deaf is also due to increase, as will the number of those suffering from mental diseases.

---

* From a paper read on September 18 at the Bicentennial Conference, University of Pennsylvania.

FORTHCOMING EVENT

Friday, November 1

North-East Coast Institution of Engineers and Shipbuilders (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne) at 6 p.m.—Prof. W. M. Thornton: "Foundations of the Electrical and Mechanical Transmission of Energy" (Ninth Andrew Laing Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Resident Lecturer (Woman) in Geography—The Principal, Training College, Darlington (October 31).

Deputy Director of Education—The Director of Education, Education Office, South Parade, Nottingham (November 2).

Assistant, Grade III (Woman), at the Water Pollution Research Laboratory, Watford, Herts.—The Establishment Officer, Department of Scientific and Industrial Research, Teddington, Middx. (quoting J40/10) (November 4).

Assistant Bacteriologist in the Department of Preventive Medicine—The Registrar, The University, Bristol 8 (November 11).

Woman Lecturer in Education—The Principal, Saffron Walden Training College, Saffron Walden, Essex.

Lecturer in Geography and a Lecturer in Physics able to assist with Teaching of Mathematics—The Registrar, Municipal College, Portsmouth.

Graduate Master to teach Science in relation to Building and Engineering at the Beckenham Technical Institute—The District Secretary, Kent Education Committee, 12 Beckenham Road, Beckenham.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Rubber and Agriculture Series, Bulletin No. 14: A Method for the Application of Sodium Chlorate to Bracken. By Dr. G. H. Bates. Pp. 6. (London: British Rubber Publicity Association.) Free. [1010

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 4: Maxwell's and Dirac's Equations in the Expanding Universe. By Erwin Schrödinger. Pp. 25–48. 1*s*. Vol. 46, Section A, No. 5: Notes on the Electrochemistry of Gases. By K. G. Emeleus and Jean W. Beck. Pp. 49–64. 1*s*. Vol. 46, Section A, No. 6: Estimation of the Air–Earth Current. By P. J. Nolan. Pp. 65–76. 1*s*. Vol. 46, Section A, No. 7: The Equilibrium of Ionisation in the Lower Atmosphere. By J. J. Nolan. Pp. 77–90. 1*s*. Vol. 46, Section A, No. 8: Velocity Distributions in a Field of Force. By W. C. H. Eakin and W. H. McCrea. Pp. 91–102. 1*s*. Vol. 46, Section B, No. 4: River Liffey Survey, 3: The Growth and Food of Young Salmon. By Winifred E. Frost and Arthur E. J. Went. Pp. 53–80. 2*s*. Vol. 46, Section B, No. 5: Report on a Further Exploration (1929) of the Caves of Keshcorran, Co. Sligo. By A. M. Gwynn, F. T. Riley and A. W. Stelfox. Pp. 81–96. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [1410

Other Countries

U.S. Department of Commerce: National Bureau of Standards, Research Paper RP 1307: Influence of Cyclic Stress on Corrosion Pitting of Steels in Fresh Water, and Influence of Stress Corrosion on Fatigue Limits. By Dunlap J. McAdam, Jr., and Glenn W. Geil. Pp. 685–722+29 plates. (Washington, D.C.: Government Printing Office.) 10 cents. [810

Bulletin of the Raffles Museum, Singapore. No. 15: A Handlist of Malaysian Mammals; a Systematic List of the Mammals of the Malay Peninsula, Sumatra, Borneo and Java, including the Adjacent Small Islands. By Frederick Nutter Chasen. Pp. xx+209. (Singapore: Government Printing Office.) 5 dollars; 11*s*. 2*d*. [1010

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1939. By J. P. Mead. Pp. iv+100+4 plates. (Kuala Lumpur: Government Press.) 1 dollar; 2*s*. 4*d*. [1010

U.S. Office of Education: Federal Security Agency. Bulletin, 1939, No. 13: Conservation Excursions. By Effie G. Bathurst. Pp. vi+106. 15 cents. Bulletin, 1939, No. 14: Curriculum Content in Conservation for Elementary Schools. By Effie G. Bathurst. Pp. vi+80. 15 cents. (Washington, D.C.: Government Printing Office.) [1410

U.S. Department of Agriculture. Circular No. 561: Importation, Rearing and Colonization of Parasites of the Oriental Fruit Moth. By H. W. Allen, J. K. Holloway and G. J. Haeussler. Pp. 62. 10 cents. Technical Bulletin No. 702: Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics; Fourth Report. By K. T. Williams, H. W. Lakin and Horace G. Byers. Pp. 60. 10 cents. (Washington, D.C.: Government Printing Office.) [1410

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 2, 1940 No. 3705

COLONIAL FORESTRY AND COUNTRYSIDE PROBLEMS

BUT a short while ago this heading would have been written in an inverse order, that is, countryside problems and forestry, the greater stress being laid on the former. In some matters, the British are ultra-conservative; the more so perhaps where ignorance of a subject leads them to an instinctive opposition and disinclination to move in a, to them, unknown direction. In no department of administration has this national trait become more evident than the forestry departments throughout the Empire. India early broke loose from this official inertia, owing to a fortunate combination of clear-headed, wide-visioned Secretaries of State and competent Governors-General. The extensive, valuable and well-administered Indian forests are witness to this fact.

In the Colonial Forest Services, on the other hand, a very different position had gradually arisen. Forestry was completely misunderstood. It was thought that totally undeveloped areas of existing forests, supervised by small inadequate staffs, should pay their way almost from the start or they were not worth the trouble and expense of administration. The Secretary of State left matters to the individual and constantly changing Governors, who, with no knowledge of forestry principles, were for the most part guided by their financial advisers; these latter regarded a forestry department merely as a potential source of revenue, the expenditure of which was ruthlessly cut when for various perfectly justifiable, in fact often obvious, reasons, the anticipated revenue was not forthcoming.

Although lip service had been given in expressions of opinion on the value of forests and their protection, etc., until well within the last decade there had been no real attempt at a continuity of management, with one or two notable exceptions, in the forestry services under the Colonial Office. An awakening had commenced and the present War appears to have hastened it.

The annual report of the Uganda Forest Department for the year ending December 31, 1939 (Entebbe, Govt. Printer, 1940) opens with a quotation from the Secretary of State for the Colonies (taken from "The Colonial Empire," Cmd. 6023, 1939) as follows: "Forestry Departments are becoming more and more involved in the study of general rural development and land use and contacts between them and other departments engaged on similar work have been strengthened."

In his introduction, the conservator of forests, Mr. N. V. Brasnett, who had been working closely with the director of the Geological Survey of the Protectorate, enunciates once again the time-honoured principles of a forest policy dealing with forest reservation; obtaining the best financial return for the forest estate; encouragement to private forestry, whether by native enterprise or private individuals; and propaganda towards giving the people a knowledge of the value of forests both to themselves and to their posterity. There appears to be hope that Uganda, in spite of the War, will now be granted the facilities to put in force, practically, these articles of the forestry creed.

In the annual report of the Forestry Department for Nyasaland for the year ending December 31, 1939 (Zomba, Nyasaland, Govt. Printer, 1940) the Conservator, Mr. J. B. Clements, develops the same theme.

It is pointed out that the outbreak of War has enhanced the need for making the Protectorate independent of imported soft woods, and particular attention has been given to means of increasing the outturn of local timbers for building purposes, both hard wood and planted soft wood, in anticipation of increased demands. The village forest area scheme is providing a valuable reserve of poles and firewood near the villages themselves which did not exist a few years ago. This enables the urban natives to obtain these materials at low rates from forest reserves near the townships—a benefit now becoming appreciated by those responsible for the administration of improvident populations in tropical countries.

In the connexion here dealt with, the following depicts the new position as regards the forests, which is acquiring definite recognition. Alluding to a draft revision of forest legislation during the year, the Conservator says that the revision had become necessary for two reasons: (*a*) the change in status of various classes of land (native forest land) brought about by the Order in Council, 1936; and (*b*) the need for the gradual devolution of responsibility for forest protection and management to native authorities, and for their participation in a share of forest revenue. The Agronomic Sub-Committee of the Native Welfare Committee simultaneously put forward suggestions to Government for the enaction of legislation to implement soil conservation policy relating to all classes of land.

These proposals, together with those for the revised forest legislation, mark an important stage in efforts towards reform, and bring new emphasis on land conservation both as regards the selection of land for various purposes, and the conservative treatment of lands selected for agriculture and grazing. The land protection involved in forest policy, namely, the constitution of forest reserves in important catchment areas and watersheds, the closure to cultivation of steep hill slopes which in many cases become village forest areas, the enforcement of stream bank regulations, forms a really satisfactory nucleus for complete land planning in very many regions.

This encouraging departure, which in one form or another is making its appearance in other parts of Africa, will need the most careful supervision on the part of Governors, the civil administration and the Conservators, if it is to justify the high hopes which its introduction gives rise to. The education of populations accustomed from time immemorial to treat the forests as a property of no value will not be completed in a day.

CULTURE OF THE NUER

The Nuer
A Description of the Modes of Livelihood and Political Institutions of a Nilotic People. By Dr. E. E. Evans-Pritchard. Pp. xii+271+30 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 17*s*. 6*d*. net.

To understand Dr. Evans-Pritchard's admirable account of the Nuer, a pastoral group inhabiting the swampy lowlands south of the junction of the Nile with the Sobat and Bahr el Ghazal, one must learn to think in terms of ox or cow (the ambiguity of these words in the English language showing how far we have degenerated in this respect). For it is explained that "their social idiom is a bovine idiom". Thus their difficult cattle terminology of colour, age and sex—the colour scheme is given us in a dozen striking diagrams—affords the chief clue to their marriage arrangements, ritual and law. Even kinship, that basic fact in the sociology of any primitive community, is customarily defined by reference to payments of cows in the form of dowries and other wedding-presents; so that "movements of cattle from kraal to kraal are equivalent to lines on a genealogical chart".

Thus this study by Dr. Evans-Pritchard, which is singularly successful in harmonizing a descriptive with an analytic interest, moves naturally forward from an examination of the ecology—that is, the economic life as determined by the physical conditions and state of the arts—to a review of the social organization as consisting in three complementary elements, the political system, the lineage system, and a peculiar system of 'age-sets', the sentimental bond uniting fellow initiates. The book, then, is remarkably compact, and the author is much to be commended for achieving so neat a synthesis ; even if it is only fair to allow some of the credit to the Nuer themselves for conceiving life as so well-rounded a sphere of functions and values.

Though he lays but little stress on the personal side of his experiences, the author could scarcely have enjoyed playing 'parasite of the cow', as every Nuer is only too happy to do, luxuriating not only in its milk, meat and blood, but in its more odoriferous products ; so that animals and humans wallow in the same fetid and insect-haunted byre with that immunity to squeamish humours which precedes the evolution of the sanitary inspector. Nay, our veterinary experts would likewise be out of place here ; for it is argued in some detail that, although the cattle-husbandry of the Nuer is in important respects out of keeping with our conventions of farming, their methods work well enough for them, and could not be altered without involving a fundamental change in their whole method of life. In fact, as so often, civilization in its most benevolent mood might easily make an end of their ancestral habits and of them together.

True, the Nuer are partly dependent on the cultivation of millet—though millet without milk strikes them as highly unpalatable ; and are also handy at spearing fish. But it is not the nutritive so much as the social importance of the cow that ensures its pre-eminence in their vital economy. A man and his favourite beast become one in name, that is, for the primitive intelligence well-nigh one in soul ; and the cow-name received at birth, and by which he was known to the playmates of his youth, will after death be handed down to posterity as if such an identification were a fuller expression of his inward being.

Another way of realizing how the culture of the Nuer is founded on one idea, one passion, is in the light of their saying : "it is cattle that destroy people". Not only among themselves do they indulge, as did our own ancestors, in the honourable sport of cattle-raiding, but this is the main cause of war with their neighbours, the Dinka, as also of trouble with the Government, the earlier methods of which indeed do not seem to have differentiated between cattle-raiding and tax-gathering as clearly as might be desirable. Feuds being composed by fines, blood-wealth, with bride-wealth rising and falling in harmony, provides the standard governing all commercial transactions, which are thus 'pecuniary' in the etymological sense. Indeed, to understand the political system in all its ramifications, it is sound policy to start from a blood feud involving in the first instance small agnatic groups. This thereupon creates an enmity spreading through a network of kinship ties, until the interrelations of whole communities are influenced as they variously seek vengeance or arrange for compensation. All this militant clannishness makes for a spirit of dour independence and pride which the European visitor may easily resent as an ill-mannered truculence until he learns to understand their life and accept their values. It takes an anthropologist of Dr. Evans-Pritchard's insight and breadth of mind to do this ; and therefore, if only because it is so fair to the facts, spiritual and material alike, does this book deserve to rank as a masterpiece of scientific interpretation.

R. R. Marett.

THE SCIENCE OF PLANT PROTECTION

The Scientific Principles of Plant Protection
With Special Reference to Chemical Control. By Dr. Hubert Martin. Third edition. Pp. x+385. (London : Edward Arnold and Co., 1940.) 22*s*. 6*d*. net.

The need for methods of plant protection arises because, when plants are grown close together as a crop under favourable growth conditions, far greater opportunity is provided for the spread of pests. A fungus grown on a single plant has small chance of survival, but when there is a crop of many acres the conditions for the multiplication and spread of the fungus may render it a factor of primary and adverse importance.

Plant protection has become a science involving partnership between the biological sciences of entomology, mycology and plant physiology, and the physical sciences of chemistry and physics. Success involves their closest co-operation, for which an understanding of the scientific principles involved is essential : the book under notice seeks both to survey these as well as to provide a book of reference on insecticides and fungicides.

The methods of plant protection can be classified as preventive and curative. More or totally resistant varieties of the host plant may be selected and propagated ; it may be protected by a chemical or by a combination of climatic and biological factors. The parasite may be destroyed on the seed or in the soil by a variety of methods. It may be attacked by toxic chemicals after its action on the plant has begun.

The greater part of the book is devoted to the consideration of fungicides and insecticides. The chemical manufacturer is becoming more and more attracted to this field as an outlet for his products on the large scale, and an extension of chemotherapeutic knowledge is enabling a widely extended range of chemicals to be tried, not merely empirically, but as the result of the correlation of structure with toxicity. The physicist is at the same time learning to understand the theory and technique of spraying, dusting and fumigating with liquid, solid and gas. Hence he has been able to lead on to spreaders, stickers and emulsifying agents so as to promote the formation of the liquid/solid interface.

Fungicides are based on sulphur, copper, arsenic and fluorine compounds as well as on such organic substances as nicotine, pyrethrum, rotenone. Other materials are being tried in the laboratories, where a technique of measurement is being elaborated as a preliminary to establishing the connexion between toxic action and chemical constitution. Quite another class of chemicals serve as fumigants.

The magnitude of the subject will be apparent from the foregoing remarks. The author has in this third edition made good use of his earlier experience and produced an up-to-date and at the same time stimulating account of the subject. The research station at Long Ashton, from which the book is dated, can regard it as worthy of the scientific standing of the laboratory.

E. F. Armstrong.

ELEMENTARY BIOLOGY

Intermediate Biology

By W. F. Wheeler. Pp. xiii+530. (London: William Heinemann, Ltd., 1940.) 15s.

THE remarkable development of biology in schools during the last decade has been accompanied by the inevitable spate of text-books which follow on the introduction of a new subject. The majority of the writers of these text-books have been stirred to produce works which would include cognate topics relating to the syllabuses of the various examining bodies. From the authors' points of view, it is a little unfortunate that the rapidity of the growth has been accompanied by the constant revision of examination syllabuses in biology, with the result that many of the books produced have quickly become unsuitable. Mr. Wheeler's book has been prepared to meet the demands of present-day students offering biology at higher school certificate, intermediate degree, pre-medical and allied examinations.

In the succinct accounts of the anatomy and embryology of the 'types' set in the plant and animals section of the various syllabuses, the author adheres rigidly to the standard of knowledge that might be expected of Intermediate students, the descriptive technique showing little advance on that in use some ten years ago. A useful innovation is the inclusion, at the end of some of the chapters on animal types, of a short section in which attention is focused upon the more important biological principles that the particular group illustrates. This feature could profitably have been extended to other parts of the book.

In other sections relating to the cellular structure and comparative physiology of organisms, the author has added a valuable contribution to the teaching of biology, as distinct from the daughter sciences of botany and zoology. The main biological principles are considered in terms of living organisms, plant and animal, adequate attention being devoted to the peculiar as well as the conforming types. Apart from the confused description of hormonal reactions in plants, these sections are clearly set out. The chapters on heredity, evolution and the relation of the organism to its environment are stereotyped, except for a concise description of the evolution of the vascular and urinogenital systems. The latter will probably be ineffective for the type of student for whom the book is intended, but, with a curtailment of detail, would perform useful service in any future edition.

The book is profusely illustrated, many of the diagrams having been taken from books already in use; the original figures are good, although, in contrast to some text-books in school biology which have been published recently, add little to established text-book illustration.

A real criticism of this, as of so many school biology books, is that the subject-matter is narrowly concentrated upon existing examination syllabuses. The need for this method of treatment is readily understood, but until writers of school text-books are prepared to include topics of wider interest to their pupils, examination syllabuses are likely to remain circumscribed.

This criticism is not intended in any way to detract from the usefulness of the book; it is eminently suitable for students preparing for the examinations mentioned above.

T. H. Hawkins.

PROBLEMS OF NEUROHISTOLOGY

Problems of Nervous Anatomy
By Prof. J. Boeke. Pp. vii+164. (London: Oxford University Press, 1940.) 7*s.* 6*d.* net.

THE disadvantage of divorce between form and function in biological study is nowhere more often seen than in relation to the nervous system. Doubly valuable, therefore, is a review of some current problems by one of the foremost living neurohistologists who, while declaring that "however valuable physiological observations may be, as long as their real histological basis is disproportionately small or entirely missing, even the best physiological theories remain nebulous", is willing to admit that "morphological details everywhere only derive their full value in view of the physiological and functional insight which they are able to furnish".

The book is in four parts, based on as many lectures given in the latter part of 1937 in the Universities of London and Oxford and to the Anatomische Gesellschaft, with a bibliography which unfortunately does not include all names cited in the text. The first part deals with cutaneous innervation, and stresses the lack of a known structural basis for many clinical and experimental observations on cutaneous sensibility. Boeke rejects Head's view that two different kinds of nerve fibres are concerned with protopathic and epicritic sensation. In the light of recent histological, developmental and experimental studies, he suggests that protopathic sensation is the outcome of incompletely regenerated end-organs and as yet unmyelinated nerve fibres. He directs attention to the rich sympathetic plexus in the dermis, but the absence of all 'endings' in this plexus leads him to conclude that it is efferent in function.

In the next two parts the author develops a consideration of this "sympathetic ground plexus" in many parts of the body, and identifies the cellular elements in the plexus with the interstitial cells of Cajal. Boeke's review of the vexed question of the interstitial cells is one of the most useful things in his book. He thinks them to be of great phylogenetic significance in attempting to relate the vertebrate nervous system, with its highly organized cell patterns, to the simple nerve net of the lower invertebrates. This section was written before Prof. Woollard's last paper, in disproof of the invertebrate nerve net (Woollard and Harpman, *J. Anat.*, 73; 1939). But Woollard's work, so sadly cut short, cannot be taken as conclusive, though it does imply that re-examination of the invertebrate nervous system is needed before further theoretical correlations are established. What neither the protagonists nor the antagonists of the nerve net seem to have considered is the relation between the "ground plexus" and the vascular system, which is undoubtedly retiform in its development and remains so in its periphery. Some of Boeke's own figures of the ground plexus strongly suggest a capillary relationship. How far is the one the trellis along which the other grows?

Several threads in the earlier sections are taken up in the last part, which is a review of the present state of the neurone doctrine in the light of modern physiological conceptions of the inter-neuronal synapse. It is a wise and thought-provoking chapter, which demands that out-worn concepts and conflicts be discarded so that fresh attacks can be made upon basic problems of neurology in the unhindered light of newer knowledge. Here, as elsewhere in the book, is evidence of the mature judgment, open mind, and breadth of vision of the man who has succeeded Cajal as the doyen of neurohistologists.

D. M. Blair.

NUTRITION IN WAR-TIME

Nutrition and the War
By Dr. Geoffrey Bourne. Pp. xii+126. (Cambridge: At the University Press, 1940.) 3*s.* 6*d.* net.

IN Great Britain there has been, in the last few years, a great improvement in the national dietary which has been accompanied by a corresponding improvement in national health. The limit of improvement has not yet been reached. The increase in physical fitness of recruits drawn from the poorer class after a few months in the Army and of slum children evacuated to the country is an indication of the extent to which national health and physical fitness can be still further increased. All we have learned of nutrition in the last twenty-five years suggests that food is probably the most important factor in this improvement in physical fitness. The author of this little book gives some striking illustrations of the connexion between diet and physical fitness.

In the present struggle for our existence it is of the utmost importance to have the whole population in the highest possible state of physical fitness, upon which morale and fighting- and working-efficiency so largely depend. An important part of our war effort should be making the national diet fully adequate for health. At first sight, there would appear to be great difficulty in improving the national diet under present conditions when we are threatened with a shortage of some foods. Fortunately, however, it is possible to provide all the health factors from a few foods which we can produce in sufficient amounts at home.

The two most important 'protective' foods are milk, including dairy products, and vegetables, including potatoes. If consumption of these among the poor be brought up to the level among the well-to-do, we need have no fear of deterioration of the national diet in war. These foods should, therefore, receive priority in home-production. As the author of this little book points out, a reduction in the milk supply is likely to cause widespread ill-health, especially among children, whereas a reduction in the beef supply by even as much as 50 per cent would not necessarily be serious. There may be a great reduction in imported fruits, but this also need not be serious because all the nutrients of special value for health contained in fruit can be obtained from vegetables and potatoes. Fortunately, vegetables and potatoes are two of the crops which give the highest yield of food per acre, and the milk cow provides four or five times as much food for the feeding-stuffs consumed as the bullock. If our agricultural policy be based on nutritional needs, there is likely to be an increase in the production of these, even at the expense of less essential foods.

The Government may provide the food, but its efficient use depends on the housewife. The Ministry of Food is carrying out an extensive propaganda to bring the knowledge of nutrition to every household. This publication is designed to serve the same purpose. It deals mainly with the nature and composition of various foodstuffs. It gives the calorific value and an indication of the protein, vitamin and mineral content of a long list of foods. This will be of interest to the scientifically minded housewife. But, however much the experts may theorize about the perfect diet in terms of calories and vitamins, the well-to-do will continue to eat what they like and the poor to eat what they can get. The well-to-do are well fed. It is the poor who are ill-nourished. The problem of malnutrition is mainly an economic problem. Measures, such as the new milk scheme, which enables the poor to get milk for women and children at a reduced price, the allotment scheme, which provides cheap vegetables for families, and the placing of wholemeal bread on the market at the same price as white bread, are likely to do more to improve nutrition among the poor than technical instructions on food values.

AIR SURVEY

Air Photography Applied to Surveying
By Dr. C. A. Hart. Pp. xx + 366 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 25*s*. net.

No one could be better qualified than Dr. Hart to write this book, on the use of air photographs in the making of maps. Unfortunately for the advocates of this new method of surveying, they have had not only to amplify and perfect the instruments, the cameras and aeroplanes as well as the ground instruments, but they have also had to persuade the future users of the maps and surveyors that the resultant maps in many cases will be better in quality, quicker and cheaper in execution, and more accurate than maps made by older methods. Now when we consider the reasons for this rather curious state of affairs, we must attribute the blame fairly between the conservatism of surveyors and the over-statement of the merits of these air survey methods by some of the original advocates. There is, moreover, one other reason, and that is that this new method was left to commercial companies to develop, while heretofore it had always been Governments which had supplied maps. It was therefore often difficult for a man to realize that the sheet he could buy for 2*s*. 6*d*. had cost thousands of pounds to survey, and that the advocate was not only trying to sell him something, but also to sell something really good.

These points, and the original history and gradual introduction of air survey methods into the making of modern maps, are very clearly brought out in this book. Dr. Hart is not only a surveyor and therefore a maker of maps, but also, as an engineer, one of the users of maps. We therefore have both sides of the question fairly represented.

To the makers of maps we commend the technical chapters, which are full, accurate and clear; to the future users of maps who still may have a lurking doubt as to the value of air photography as a sound method, we recommend the earlier chapters; and to the field surveyor we would add that ground survey will still remain as valuable and as necessary as ever.

The introduction of air photography, either vertical or oblique, is a somewhat similar epoch in the history of surveying as was the introduction of the plane table; only the older of us can remember the introduction of this instrument from India, and its rejection by many in England who preferred the chain and compass method.

Of late years the methods of air surveying have been greatly improved, and thanks are due to those like Cochrane-Patrick and others, who laid down their lives in the execution of air surveys, and to Kemp, Hemming and others who not only carried out surveys but also advocated and advertised their utility to a too often incredulous client. Air photography applied to surveying has come to stay.

Dr. Hart's book is a very good one, and Sir Alexander Gibb's foreword most appropriate.

C. H. D. R.

COKE AND ITS PROPERTIES

The Quality of Coke

Being the Second Report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council. By Dr. R. A. Mott and Prof. R. V. Wheeler. Pp. xxxv + 464. (London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

THE literature on cokes until about twenty years ago concerned itself mainly with analytical information. Knowledge of their properties in use was mainly empirical, and to many important questions no answers could be given. In the meantime, a very large amount of experimental study has been devoted to the subject by research workers, and in Great Britain by committees established by producers and users of cokes. The Midland Coke Research Committee has issued two reports—the first in 1930—of work done under the direction of the late Prof. R. V. Wheeler and Dr. R. A. Mott. The second and present report was ready for issue just before Prof. Wheeler's death last year, and was his last publication.

Among common commercial products cokes are distinguished by a peculiar combination of qualities, the united effect of which determines their usefulness. These properties are both chemical and physical. Some are inherited from the parent coal and even when disguised by processes of manufacture are nevertheless detectable in the finished product. Thus raw coals are not homogeneous but possess a banded structure, evidence of which can be found in cokes. The properties of a coke can be influenced by conditions of carbonization and by treatment after manufacture. Again, even the densest coke contains 75 per cent of free space consisting of pores varying widely in size. All these properties combine to determine the behaviour of the product, which is normally consumed in lump form. Laboratory work, when, as is usual, made on samples in the form of fine particles, cannot take account of the differences due to size and structure of lump coke. This omission reduces the weight of the conclusions of many workers. Large-scale work is laborious and costly, but necessary to reveal the incidence of certain factors. It is the merit of the work in this report under notice that it is mainly about material in commercial form.

In the combustion of cokes, two chemical reactions are of primary importance: (*a*) the union of carbon with oxygen to form carbon dioxide and liberate the heat of combustion; and (*b*) the reaction of carbon with carbon dioxide in the fuel bed. Although at low temperatures cokes differ in their reactivities to oxygen, above a red heat the rate of reaction is so great that no differences can be measured. Rate of combustion is determined by rate of air supply, and differences in 'reactivity to oxygen' have no significance. At lower temperatures, differences can be measured and are significant in all those processes where a coke must attain or maintain combustion at temperatures up to a moderate red heat. This is generally the case in domestic grates, boilers and stoves burning at a low rate of combustion and usually in a small fuel bed. Under these conditions, the differences in chemical reactivity to oxygen between cokes of different origin and process are significant.

On the other hand, in industrial processes at high temperatures and in large fuel beds, the dominant factor is usually mechanical strength—resistance to 'shatter' and 'abrasion' in handling and movement during combustion. Anything that interferes with the free passage of gases through the fuel bed reduces the serviceability of the fuel. Indeed, chemical reactivity may accentuate this diminution by promoting the reaction of the carbon with the carbon dioxide present in the fuel bed. By this reaction carbon is consumed with absorption of heat already liberated by the combustion of carbon with oxygen, and temperature rise is hindered. The manner in which these various factors are interwoven in different fuel processes forms the subject of the experimental work recorded in the report.

It should be mentioned that the Research Committee is interested primarily in the products of the large coke oven. Gas works coke, made to-day predominantly in continuous vertical retorts, has qualities which receive little prominence in the report. Nevertheless, it is the most comprehensive account of work on the qualities of cokes available in Great Britain, and is indispensable to all interested in this branch of technology.

H. J. Hodsman.

BUSINESS MANAGEMENT

(1) The Science of Production Organization
By Prof. E. H. Anderson and Prof. G. T. Schwenning. Pp. x + 282. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 17*s.* 6*d.* net.

(2) The Economics of Business Enterprise
By Prof. Walter Rautenstrauch. Pp. xiv + 446. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 20*s.* net.

BOTH these books are further contributions to the already extensive American literature on business management.

(1) The first, dealing with production organization, seeks to gather up and correlate recent writings on the subject, to smooth out and reconcile apparent contradictions, and to point the true path to further progress. There are doubtless still many who regard the extreme analysis of business methods and the more advanced tenets of scientific management with some distaste, not to say great aversion; but whilst industry and trade remain largely on a competitive basis—and possibly still more so if they were on some other basis—it appears to be a primary need to seek out the best and most effective methods of running a business. This necessarily involves a close study of the science of organization, and the book before us gives, lucidly and concisely, within the comparatively short compass of some 250 pages, much of the best of recent American thought in this field.

After a preliminary clearing up of definitions, the authors deal with the growth of organization ideas from the time of Adam Smith; the organization of work; organization structure; types of organization-line, line-staff, functional, and committee; comparison of these; principles and laws; and broader aspects. The analytical mind at least will probably study with some interest the discussion of Gilbreth's 'therblig', the unit of human effort which F. W. Taylor had sought for in vain. There are at present eighteen of these, with promise of more to come, and the authors think the 'therblig' is destined to become a standard unit of manual productivity and possibly of labour cost. A fairly extensive and carefully selected bibliography is appended.

(2) The second work is rather more formidable —more than four hundred pages and a longer bibliography—and yet its modest aim is merely to serve as an introductory text on *some* economic problems of business enterprise. It is also much more concrete in that its chief pre-occupation is with practical methods for dealing with such things as cost estimating, interest and depreciation, evaluation of machines, materials and supplies, interpretation of financial statements, together with an interesting discussion of business enterprise in general illustrated with valuable examples of actual American businesses taken from a wide range of industry. Another admirable feature which gives a welcome realistic touch and a satisfying method of grasping the subject-matter is the addition of problems at the end of each chapter. There are numerous tables and a certain amount of fairly easy mathematics.

Costing and accounts executives who wish to add to the basic knowledge underlying their particular fields of action will find much of interest and value. Prof. Rautenstrauch certainly seems to have done a good piece of work, something more than an introductory study, and has adequately fulfilled his purpose of "stating what is generally considered to be good practice in dealing with the economic problems of specific business enterprise, inquiring into theories on which these practices rest, and developing methods of analysis" for dealing intelligently with the economic problems of a given business. But although he goes very thoroughly into the questions of costing, he does not seem to worry much about the 'therblig'.

ECONOMIC RESOURCES AND THEIR EMPLOYMENT*

By Dr. Wesley C. Mitchell,

Director, National Bureau of Economics Research, New York

THE most important resource available to man is knowledge, for the materials and forces in his environment become useful to him only as he learns about them, and through science and technology converts them to his needs: In view of this fact, any denial of the right to follow the truth wherever it leads will assuredly hamper the future growth of science and so dim humanity's prospects. To-day, the widespread recognition of the fundamental importance of study and research to society is indicated by the huge sums and vast amount of energy invested in schooling and development of new techniques.

Essential, then, is the task of conserving for future generations these resources, lately become precious because of autocratic pressure in various quarters of the globe. Knowledge is power; it holds the key to all other resources and the better way of life which all men are seeking. Those democracies still existing must examine to what extent they are prepared to defend their right to gain knowledge. Scientific research, more than any other type of activity, requires freedom. The man who makes discoveries must be free to ask sceptical questions. Dogmas have ever been the foe of science, and science the destroyer of dogmas.

The modern classification of resources made by economic theorists is essentially that devised by Ricardo more than a century ago, with a few modifications. Whereas Ricardo thought of the annual produce of society as being divided into rent, wages and profits, to-day we think of interest as distinguished from profits and capital as distinguished from business administration. In our day most people get their living by making and spending money incomes, making it obvious that the processes of producing and distributing wealth have become interdependent.

The development of man's most important resources has enabled him to command innumerable natural forces and convert to domestic use many things which at one time in history were dangerous. The process, of course, started ages before records were kept, and the triumphs of science since the days of Galileo and Dalton have covered so wide a range, and have yielded so many practical applications, that we have acquired an almost mystical faith in its ability ultimately to solve the problems that still baffle us—provided we do not stop the process of discovery by using the present powers of science to destroy ourselves and our culture.

Study of the development and utilization of the economic resources in our culture, however, gives no reason for believing that the form of economic organization influences the occurrence of scientific genius. Certainly some of the great early discoveries came from economically backward countries—for example, Copernicus from Poland, Galileo from Italy, Descartes from the *ancien régime* in France, Leibniz from cameralistic Germany. But I do think that capitalism provides conditions far more favourable to the practical application of scientific discoveries and the work of the world than the economic forms it has gradually displaced. While capitalism nurtured the Industrial Revolution, it is true also that the Industrial Revolution has in turn fostered science. An excellent example of this is to be seen in the great assistance given to biologists, anthropologists, geophysicists, meteorologists, and by rapidly expanding world trade. Slowly but surely, business men are learning the value of research for their particular needs.

But this alliance between research and business developed latent incompatibilities between the temperaments of the two. Business enterprises have uses for science in so far as it promotes their pecuniary aims. They maintain research staffs to study their problems, but do so chiefly with the expectation of keeping newly discovered ideas in reserve until business conditions make their use expedient. In many an American corporation tension has developed between the engineering staff interested in technological perfection and the financial executives interested in profits. This gives evidence that our economic organization, in spite of its prodigious efficiency in comparison with the forms it has superseded, still fails to make full use of the resources at its command. This is true even at times of greatest expansion. A great increase in the output of useful goods—no one can say how great—might be effected if we employed our basic resources of knowledge to the full.

Even though we do not make full use of our economic resources, we are nevertheless using up certain of them at a rate that rouses grave apprehension as to the future. Forests are disappearing, valuable soils are being eroded, animal species are being exterminated, and coal, petroleum, natural gas, and mineral ores are being used in prodigious quantities. If these inroads upon Nature's cupboard continue to grow for a few generations, the cupboard will be bare of many treasures that have become almost indispensable to our culture.

---

* Substance of an address given on September 17 at the Bicentennial Conference of the University of Pennsylvania.

Books have been written on the problems created by large-scale industry, recurrent business-cycles, giant monopolies, waste of natural resources, etc.; but underlying all these problems our economic difficulties are a result, primarily, of an uneven growth in different parts of man's knowledge.

One group of sciences which, compared to the natural sciences, has not yet reached adolescence, is the social sciences. Many more benefits might have accrued to society from its rapidly increasing mastery of Nature had not the progress of discoveries and applications of the social sciences lagged behind those of the natural sciences. The explanation of this lag is apparent. The social scientist deals with man—a far more complex being than the materials with which the natural scientists deal. He is variable to responses to given situations and is far less susceptible to control by an investigator. Social inventors likewise have an excuse for their paucity of gifts to mankind. The social inventor does not have a large body of precise tested knowledge to draw from; seldom does he have the opportunity for extended and methodical experiment. Unless money is to be made, society is indifferent. Quite often governmental action is necessary before a trial can be made. In this connexion, the necessity for a changed social point of view to expedite the lagging progress of the social sciences has been employed.

The hesitant progress of the social scientists and social inventors does not indicate that all hope of progress has gone. Undoubtedly advances in knowledge of human behaviour have been many since the time of Adam Smith. Many data concerning individual social behaviour have been assembled and classified. Social inventions have been made also, for example, the limited liability of stockholders, cartels, chain stores, birth control, social insurance and the parole system.

If our inability to make full use of our other resources is due in large measure to maladjustments among economic processes, and if economics has developed methods that promise to make it more applicable to actual conditions, then enlightened citizens should do all they can to promote social research in general and economic research in particular.

Of course, no certain returns can be guaranteed upon research of any type, but a success here and there may repay many times over not only the direct costs of the successes themselves but also the cost of numerous failures. For example, the many millions of dollars per business-cycle that society would gain from a mitigation of cyclical contractions would justify investing some millions in trying to find out how the flows of products, incomes and purchases can be kept better balanced. To gain a billion it is mathematically worth while risking a million, if the chances of success are more than one in a thousand. A nation whose current annual income is estimated at seventy thousand millions would be wise to accept the odds.

Since the day of the French physiocrats and Adam Smith, economics has breathed the breath of freedom. The autocracies' way of using resources to aggrandize the State is a serious threat. Admitting certain immediate benefits to be derived from the totalitarian form of government, it is still difficult to believe that this demonstrates that autocracy is more efficient than democracy in satisfying the wants of its citizens. Of course, if these citizens have been brought to the point of preferring their individual shares in military triumphs to "life, liberty and the pursuit of happiness", they must be satisfied for the time being. For this military gratification, they are paying a heavy price in the severe sacrifices which are imposed upon them in their daily lives.

All of us realize that democracy is far from perfect, but we prefer it infinitely to a system under which compulsion rules. Our economic organization works out results that satisfy no one; but with all its faults it produces a higher standard of living at the cost of less effort than any autocracy has shown.

The present world conflict does not demonstrate conclusively that autocracy confers great military power upon a nation in the long run. All that is clear is that a heavily armed nation governed by a single will is for a while more than a match for nations that have neglected their defences materially and morally. But since war depletes irreplaceable natural resources with utter recklessness, there is more than ever a need to cultivate the one great resource that can be increased and through its increase made to open other resources, namely, scientific research; and since scientific research requires freedom, in defending freedom we are also protecting the future of mankind from a deadly menace.

The real strength or weakness of democratic institutions in meeting autocratic aggression will be shown by the intelligence and the wholeheartedness with which the peoples who cherish individual liberty behave in the next year or two.

MEDICINE IN WAR-TIME

By Prof. J. R. Marrack,

London Hospital Medical College

SOME twenty years have passed since the Medical Research Council published a Medical Supplement to the War Office *Daily Review of the Foreign Press*. In those twenty years the foundations of medicine have been widely extended, the methods of medicine have continued to shift from treatment towards prevention and, particularly in the last few years, the general outlook of men of science has changed from a detached aloofness towards active participation in the solution of social problems. Supposing that a medical man of 1918 had slept from then to now and woke up to read the first number of the new *Bulletin of War Medicine*, issued by the Medical Research Council (see p. 585 of this issue), what evidence would he find of the progress of medical knowledge and of a wider outlook ?

He would find that the treatment of wounds is still considered the most important task of medicine in war and that, as in 1918, great interest is taken in the chemotherapy of infections. Sulphanilamide, the compound recommended, is new—that he would expect ; but he would not realize, from the articles abstracted, how much more effective sulphanilamide and allied compounds are than previous chemotherapeutic agents. If he were a research worker he would be humbled when he learned the history of the discovery of sulphanilamide. For years now, patient research has been made into the nature of the specific protection given by antisera. We have learned much about the relation of such specific reactions to chemical structure. It might reasonably have been hoped that this type of research might lead to the discovery of specific therapeutic agents—the converse of Goebel's preparation of specific protecting sera by the use of synthetic antigens. Actually, the sulphanilamide compounds, which have revolutionized the treatment of septic infections, were discovered by the method of trial and error.

'Dr. 1918' might console himself by another advance in the treatment of wounds. He would find abstracts of three papers which deal with the source of infection of wounds. These are the fruit of straightforward research, particularly on streptococcal infection after childbirth. Some women carry hæmolytic streptococci in the vagina ; but it was generally agreed that these women were not particularly liable to puerperal sepsis. It was necessary to look for some source of infection outside, but it was difficult to incriminate the real source of infection, for streptococci are as widely distributed as pound notes. It is not possible to find whence a person got a pound note unless it is marked.

It has, of course, long been realized that there were many types of streptococci ; but the methods of identification presented peculiar difficulties. Now that these difficulties have been overcome and more than twenty-four distinct types of streptococci are recognized, the streptococci are 'marked'. If a streptococcus of the same type as that causing puerperal sepsis is found in the nose or throat of a person in contact with the patient, it is highly probable that this person is the source of her infection. In one series studied about six years ago the infection in 57 per cent of the cases was traced to the throat or nose of persons in contact with the patient.

This method has been applied to other infections, and the writers quoted in the *Bulletin* conclude that infection with pyogenic cocci does not usually occur when a man is wounded, but is derived from the nose or throat of an attendant or the dust of septic wards. 'Dr. 1918' might remember that, when he was admitted to a base hospital in 1917 with streptococcal tonsillitis, the man in the next bed to his had had his leg amputated at the knee ; and that the ward sister took a special pride in herself stirring up the dust of the ward with a duster, collecting at the same time a small fraction of the dust on the duster. We might conceal from him, for a time, that there are still civilian hospitals that do not use vacuum cleaners.

In the work on the treatment of shock, 'Dr. 1918' would find a direct continuation of the research and advances made during the War of 1914–18. It was then realized that some of the symptoms of shock were due to loss of fluid from the blood to the tissues and that any effective treatment must restore the blood volume. If salt solution was injected, to replace lost fluid, it also quickly escaped from the vessels. What was needed was a solution of some substance of high molecular weight, which, like the proteins of plasma, would not diffuse readily from the blood vessels and might even, owing to its osmotic pressure, suck fluid back from the tissues. Foreign proteins could not be used and human plasma proteins could not then be obtained. The obvious fluid to be used, then, was blood, although the concentration of corpuscles in a shocked patient's blood was high already (and adding more corpuscles might make matters worse, if more fluid from the injected blood was lost). Besides, blood for transfusion could not always be obtained. Solutions of gum acacia, with an osmotic pressure equal to that of plasma protein, were tried, but were not satisfactory. Attempts were made to preserve blood, but these were not successful. So for years transfusion of blood from a donor, fetched for the occasion, was used; the only advances were in details of technique and in the organization of donors.

When the rebellion started in Spain in 1936 the Catalan authorities, partly inspired by the use of cadaver blood in the U.S.S.R., organized a service of stored blood. It was found that blood could be used two weeks after it was collected. Transfusion with fresh or stored blood came to be used much more freely than before. When stories of the use of stored blood first reached Great Britain they were received with scepticism; but, as medical men who had been attached to the Government medical service returned and gave detailed accounts, the value of the method, particularly in war, was recognized. When the War broke out large amounts of blood were collected in readiness for a heavy demand; as these stores became unfit for use, they were thrown away and fresh supplies obtained. Blood was wasted and donors became reluctant to give their blood merely in order that it might be poured down the drain.

However, only the red corpuscles of the blood deteriorated in a few weeks; the plasma proteins remained as good as ever. Early this year it was realized that even when the whole blood was unfit for transfusion, the plasma could be drawn off and used. A few years ago American physicians had started to treat the œdema of certain forms of kidney disease with concentrated human serum, which had been made by evaporating serum and redissolving in a small volume. The dropsy is due to the low concentration of protein in the plasma of these patients, and by this means the concentration of protein was raised and the œdema cured. This suggested a much better way of keeping and using the surplus plasma. When dried it was convenient to store, it could be redissolved in a small volume and be used to raise the concentration of large molecules in a patient's plasma, not with a foreign substance, but with the natural protein.

It is now found to be simpler to collect blood solely for the purpose of making dried protein, to let it clot and use the serum instead of plasma. Dried serum and plasma are now being prepared on a large scale. The product is a waxy-looking solid that dissolves readily; it can be kept indefinitely at room temperature; when required for use, sufficient water is added to make up the concentration required. It seems possible that dried serum will replace blood in the treatment of shock.

All this appears obvious, but behind it lies research work that may be said to begin with the preparation of dried proteins in a soluble form by Hardy and Gardner, and includes the studies of the relation of plasma proteins to dropsy. It has had the support of the great increase of knowledge of the physical chemistry of proteins, particularly that obtained by the ultracentrifuge methods of Svedberg.

There is little, however, in these achievements that the medical man of 1918 might not have anticipated. But the recommendation in several of the papers of corticosterone or desoxy corticosterone for the treatment of shock is something that is entirely new; here, and in the paper by Mottram on "Diet in Wartime", we get hints of the great gap that lies between 1918 and 1940, of the great advance in knowledge of the working of the body.

The sterones of the adrenal cortex recall the work on endocrines—the discovery of insulin, the unravelling of the sex hormones, the separation of the various hormones of the anterior pituitary, the explanation of the action of the parathyroids, all of which have come since 1918. In 1918 adrenalin was the only hormone the structure of which was known; thyroxin had been isolated in crystalline form, but its true structure was not settled until about ten years later. Cholesterol was then an alcohol of high molecular weight; fragments only of its structure were known. The question of this structure was not settled until 1932; and new methods of investigation, X-ray analysis and the measurement of surface films helped in the solution of the problem. Now a whole series of sex hormones, the hormones of the adrenal cortex, the precursors of the D vitamins and the aglucone fraction of the cardiac glucosides, are known to have the same skeleton as cholesterol. Their structures have been established and some have been synthesized.

'Dr. 1918' knew of three vitamins, fat-soluble A, water-soluble B and the antiscorbutic vitamin. The amounts in various foods were represented by one or more plus signs. Now the amounts in food and the requirements of human beings can be given quantitatively. As with hormones, the chemist seems suddenly to have mastered the difficulties of isolating vitamins in a pure form and of analysing their structure. The structures of nine have been discovered within the last ten years; seven have been made artificially; three and a substitute for a fourth are made on a commercial scale.

The practical importance of this fourth, vitamin K, is a story of the last three years. It has been known since 1934 that the blood of chicks, the food of which did not contain this vitamin, clotted very slowly. The reason for this delay is deficiency of prothrombin—one of the normal constituents of blood plasma which is a factor in causing clotting. The amount of this factor in plasma is reduced in liver disease also; partly because bile, secreted by the liver, is necessary for the absorption of vitamin K, without which men, like chicks, cannot make prothrombin, partly because the diseased liver may not be able to make prothrombin even when sufficient vitamin K is absorbed. Because the blood did not clot, bleeding was one of the dangers of operations on patients with diseases of the liver. It is now possible to increase the prothrombin in plasma, so that the blood clots normally, by giving vitamin K and bile; provided, that is, that the liver is not so badly damaged that it cannot manufacture prothrombin. The natural vitamin, the structure of which was discovered in 1939, has a naphthoquinone nucleus with a long phytyl tail. Fortunately, synthetic compounds, without the tail, are equally effective. They are now used in treatment of patients with liver diseases, and of new-born babies with a tendency to bleed, due, also, to deficiency of prothrombin.

It is now generally accepted that vitamin B_1 forms a coenzyme that is required in the intermediate metabolism of carbohydrates in the brain; and it has recently been realized that the two vitamins, nicotinic acid and riboflavin, are embodied into compounds that act as carriers of oxygen for the oxidation of glucose. The part that these three vitamins play in the economy of the body is now settled. Here is the great difference between 1918 and 1940; in place of vague principles in some way necessary to health, we have substances of known chemical constitution which we can measure, the function of which in the working of the body we are beginning to understand.

Half the *Bulletin* is devoted to the treatment of wounds. But if the methods recommended reduced the morbidity of wounds by three quarters, they would make little difference to the issue of the War. The matters that concern medical men and that may have a decisive influence on the course of the War are preventive, namely, proper protection against air attack and the maintenance of nutrition. There is little in the *Bulletin* about either; this is due in part, of course, to the selection of papers for abstraction.

We know how much lack of food was responsible for the collapse of Germany in 1918. Both to keep our health and to sustain the maximum effort for victory we must plan our limited resources to the best advantage, and people must know how to make the best use of the food that they can get. Yet only one paper on food in war is included in the *Bulletin*. Several other valuable papers have appeared during the last year which might have been included. Yet there has been pitifully little discussion and criticism of the Government's food policy. Food is a matter of which we all know something; general practitioners, in particular, are in a good position to know about people's mistakes and wishes. Why have they not written more?

If proper protection from air attack is not soon provided, it will be difficult to maintain the production of munitions (which is not a medical matter) and the will to continue the War (which is). We have already signs of the epidemics which will attack us if the overcrowding in shelters and sanitation is not improved. It may already be too late.

One paper only in the *Bulletin* can be said to deal in any way with the protection of civilians. The abstractor is able to point out that this matter is treated excellently in the A.R.P. handbook. But what about the subjects that are not treated well in official publications? Have there been no suitable papers at least on the organization of the collection and treatment of air-raid casualties?

But the editors can take only a fraction of the blame. All people with any trace of scientific training must have realized the futility of the so-called gas-proof room, which, for years, was the form of protection recommended by the A.R.P. authorities. Yet how many individuals or organizations of men of science made any protest against this bluff; and when the A.R.P. authorities did start on real protection, how many demanded that shelters should be sufficient, sanitary—and in time?

Think how freely and vigorously the Food (War) Committee of the Royal Society criticized the Government in the War of 1914–18 and how big a part it played in shaping a sound food policy. How different our situation might be to-day if the Royal Society had appointed an A.R.P. Committee some years ago. Only an independent body can make the necessary criticism; Government advisers are too tied by loyalty and caution.

Perhaps we might find it difficult to convince 'Dr. 1918' that men of science are turning towards a more active participation in the solution of social problems.

"Curse ye Meroz, curse ye bitterly the inhabitants thereof, because they came not to the help of the Lord, to the help of the Lord against the mighty."

THE SCIENCE OF RHEOLOGY

By V. G. W. Harrison,

Printing and Allied Trades Research Association

THE word 'rheology' was coined in the United States in 1929 to denote the science of the deformation and flow of matter. Though the name is new, the science itself is old, and man has had a practical knowledge of some of the main facts of rheology since very early times. The phrase "rheological phenomena" may sound learned and forbidding; yet we study these "phenomena" every time we spread butter over bread with a knife, grease a motor-car, paint a garden shed or 'help' children make sand castles. If it be of any advantage to man to improve bread, butter, cheese, jam, chocolate, inks, paints, varnishes, textiles, building materials and a host of other everyday commodities—without which civilization as we know it could not exist—then the study of rheology needs no further justification.

It would be impossible to say who was the first rheologist. The discovery of facts so intimately connected with our daily life and associated with the very foundation of civilization was probably made gradually and by many people at about the same period. Some of the earliest handwork of man has been pottery. Pottery is made from material which is sufficiently plastic to be moulded in the hands, but retains its shape when left untouched; it must also dry out to form a rigid, hard substance. One can well imagine the early potters making experiments with various natural clays which they found; they were conducting a piece of rheological research of the first importance.

Coming to more recent times, we find Lucretius wondering why olive oil flows less readily than wine, and making theories to explain this fact not essentially different from those we hold to-day. To Heraclitus came the idea that "everything flows". Despite this good beginning, however, it must be admitted that to-day rheology, as a science, is still in its infancy, and it has received far less attention from scientific men than it deserves. Rheological research is, however, now making rapid progress, since it has been found indispensable in many industries, and it is my purpose here to describe some of the facts which have come to light, and to show how they can be used for the solution of practical problems.

The Three States of Matter

Nature is immeasurably complex, and in the early stages of learning it is a great help to classify and simplify the various facts with which we are faced. Such classifications and simplifications serve, so to speak, as pegs on which to hang our knowledge where we can see it conveniently, but, while undoubtedly useful, it must be remembered that they are man's creation and Nature herself pays scant attention to them. Thus, sooner or later, our knowledge reaches a stage when we become aware of facts which do not fit in with our artificial scheme—the classification breaks down, and we either have no "peg" on which to "hang" our fact, or, worse still, the fact looks as if it ought to be "hung" on two or three "pegs" at once and yet fits properly on none of them.

In our early days we recognize three well-defined states of matter: solids, liquids and gases. By applying heat, solids melt and become liquids, and liquids boil and become vapours or gases. Similarly, by cooling, gases can be condensed to form liquids and finally frozen into solids. The melting and boiling points are sharp and well-defined temperatures. Water is a perfect example: it freezes into ice at 32° F. and boils to form steam at 212° F.; at 32° F. you can have ice crystals and water mixed, but you cannot have an intermediate pasty substance neither ice nor water.

It is not possible to give here scientific definitions of solids, liquids and gases, but their general properties are well known. Solids are characterized by a definite shape, and other solids cannot pass through them—they can only break them. The shape of solids can be altered to some extent by the application of forces, but as soon as these forces are removed, the solid tends to return to its original shape. This characteristic behaviour is known as *elasticity*. Liquids, on the other hand, have no elasticity in this sense. They have no definite shape and solids can pass through them, though solids meet with some resistance when in motion through fluids—this is called *viscosity*. Thus glycerine is more viscous (that is, less fluid) than water. Elasticity is a property characteristic of solids, and viscosity one characteristic of liquids.

So far so good. But on further examination one finds that the distinction between solids and liquids is in some cases not so clear. For example, some materials, such as glass, have no definite melting point, but become pasty over a fairly wide range of temperature before they finally melt; in other words, the transition from solid to liquid seems to be not sharp but gradual. When they are in the pasty state, are they to be regarded as solids or liquids? There is a certain kind of marble which, when examined over a period of a few hours, appears to be a typical solid; nevertheless, over a number of years it is found to flow like a liquid. Is it solid or liquid? The older chemist used to evade such awkward questions by saying that such materials were "not pure"; however, be they pure or not, many of them are of the greatest importance in daily life, and it is the duty of the rheologist to examine their properties. One meets with surprisingly few chemically pure substances outside the laboratory.

Some of the most characteristically solid materials we possess are the metals, yet even these can, in certain circumstances, show some of the properties of liquids. An example will make this clearer. A steel wire suspended at one end from a beam in the ceiling can be overloaded so that increase in length is no longer proportional to increase in load and the wire no longer regains its original length when the load is removed: in this state engineers say that it has received a 'permanent set'. If the wire is greatly overloaded, it will be found to stretch visibly over a period of time before it breaks, and in this state it is really flowing like a liquid. The extension due to flow is many times greater than that due to true elasticity and it does not take place instantaneously. These quasi-liquid properties are of great importance from the engineer's point of view, since without them the forging and cold working of metals would be impossible. They are a mixed blessing, however, since some materials can show slight flow over a long period of time even when they are not overloaded, and such 'creep' can prove troublesome.

There is yet another effect of overloading which deserves mention. An overloaded wire is harder than the original metal was. This 'strain hardening' is familiar to the engineer; but it may be surprising to find that it occurs also with butter and cheese. Another form of overloading occurs also when metals are polished. Very high stresses are set up at the surface during the polishing operation, and the surface layers of the metal flow like a liquid; consequently the polished surface has a different structure from that of the body metal.

In certain circumstances liquids can behave in ways characteristic of solids. This is especially true of liquids of very high viscosity. For example, some bitumens are true liquids, but under ordinary conditions they flow so slowly that the movement is noticeable only after a long period, probably many days. Consequently, they can be cut like a solid. Pieces so cut will not retain their shape indefinitely, but for short periods of time they can be treated almost as solids. They even show a form of elasticity. If they are deformed by the application of a force and the force is removed after a short time, many of them will slowly recover their original shape; if, however, the force remains applied over a long period, the deformation is permanent. Certain other liquids show a form of 'flow elasticity'. If they are flowing through a narrow tube and the supply of liquid is suddenly cut off, not only does the flow from the end of the tube cease abruptly, but also the liquid actually recedes into the tube a little way.

PLASTIC MATERIALS

The materials so far examined have all been predominantly solid or liquid in character. There are, however, many materials in which solid and liquid characteristics are about evenly balanced, so that it is impossible to decide whether they are to be regarded as solids or liquids. These are said to be 'plastic', and are to be distinguished from the 'plastics', such as bakelite, which are now widely used as constructional materials in industry. True plastics have the appearance of solids and if left undisturbed they will retain their shape indefinitely. If they are subjected to a small force, they deform elastically like a solid and recover their shape (though not necessarily instantaneously) when the force is removed. Should the force, however, be increased past a certain critical value, often called the 'yield value', they flow continuously like a liquid. Consequently, plastics can easily be moulded to any desired shape and will retain that shape as long as they are left undisturbed. Potters' clay is a typical plastic. It is only because clay has these rheological properties that the making of pottery is possible.

Another familiar material which has both solid and liquid properties is flour dough. This behaves in many ways like a viscous liquid, yet it shows partial elastic recovery if a force is applied to it and removed after a short time. The recovery is not complete and it takes place gradually, so that the dough has a definite 'recovery time'. The rheological properties of dough are particularly important, since if these are unsuitable, it is impossible to make a good loaf. The properties of doughs have, therefore, been studied extensively by rheologists, and it has already been found that the addition of small quantities of certain substances, such as cystine, to the dough improve its working qualities.

'NON-NEWTONIAN' LIQUIDS

There is another property of certain materials which deserves mention. With true liquids, such as water, the viscosity is not altered by stirring; these are known as 'Newtonian liquids'. There are, however, many 'non-Newtonian' liquids, the viscosity of which is affected by stirring, and these are of considerable practical importance. This behaviour is known as 'thixotropy', and is well shown by the clay bentonite when mixed with water. When mixed in the right proportions, this sets to a firm jelly which is easily liquefied by stirring or shaking. When left undisturbed, the liquefied jelly soon re-sets. Similar behaviour is shown by many apparently viscous liquids which lose their 'body' on stirring, only to regain it as soon as they are left to settle down. For example, printing inks appear, in the tin, to be either thick liquids or solids—some have actually to be cut out of the tin with a knife. They rapidly become quite fluid on the machine, however, on account of the stirring and shaking they receive, and they can thus be distributed over the rollers to the printing block without any difficulty. Once the ink is transferred to paper, it re-sets. This behaviour is important, since inks normally take several hours to dry hard, and the initial 'thixotropic setting' helps to reduce the tendency of the wet print to smudge.

Similar to printing inks in many respects are artists' oil colours. These can be spread easily by a brush, but the colour sets rapidly as soon as the brush has left it, so that most of the brush marks are retained, giving the characteristic appearance of an oil painting. Paints are thixotropic, and they have to be so prepared that the mixture sets sufficiently slowly to allow the brush marks to flow out, but sufficiently quickly to prevent the paint from running down sloping surfaces. Heather honey, unlike honey from all other European floral sources, is also thixotropic. At rest, its viscosity is high, so that air bubbles within it are entrapped and prevented from rising to the surface; the viscosity drops on stirring, so that the honey can be spread easily by a knife. Much the same is true of butter and cheese, toothpaste and shaving soap lather.

There is another class of non-Newtonian liquid, in which the viscosity *rises* on stirring. An excellent example is a suspension of rice starch in water. This can be prepared so as to appear of the consistency of cream, when tested by gently tilting the containing vessel. The mixture can be stirred slowly without trouble. The more rapidly one attempts to stir it, however, the stiffer it becomes, and it appears to be impossible to stir it at more than a certain rate, no matter how much force is applied to the stirrer. Still more remarkable: a small quantity can be poured into the palm of the hand and will flow quite freely when the hand is tilted—nevertheless, the whole drop can easily be picked up between finger and thumb. When rubbed between the hands, the drop turns to an apparently dry powder, but it liquefies again on standing.

OTHER PROPERTIES OF MATTER

The list of curious properties of matter which the rheologist is called upon to investigate has by no means been exhausted. For example, there is 'fibrosity', or the property by which certain liquids can be drawn out into long stable threads. The formation of threads of silk and of artificial textiles is dependent upon fibrosity. Another property is 'dilatancy', by which a material increases in volume when it is stirred. Thus in walking over wet sands, the gloss disappears and the sand appears to dry out wherever the foot is placed; incidentally, quicksands are not dilatant and one should beware of wet glossy sands which do not 'dry out' when one is treading on them.

Yet another important rheological property is 'stickiness', which enters into the preparation and use of adhesives of all kinds and many other materials. There is 'oiliness', which is of vital importance in the study of lubrication. The rheological properties of rubber are so extraordinary that in text-books on rheology rubber usually has to have a chapter to itself. The properties of muscle (human or otherwise) are in many respects closely parallel to those of rubber.

Rheology thus covers a wide field indeed, and there are few engaged in science or industry who can afford to ignore it. It concerns physicists, chemists, biologists, engineers, medical men, manufacturers—in detail the list can be extended almost indefinitely. Hitherto, there has been no recognized society in Great Britain at which rheologists could meet to discuss the results of their work; consequently, there has been duplication, and, through ignorance of the work of others, the most efficient means are not always used in the investigation of practical problems. Without such a common meeting ground, no science or art can hope to make satisfactory progress. This is now realized by many rheologists, and steps have been taken to establish a British Rheologists' Club (see NATURE, October 19, p. 518) which, it is hoped, will serve these needs in an informal way during the present emergency; and in the industrial reconstruction which will follow the War, we may expect rheology to play an important part.

OBITUARY

Sir Henry Head, F.R.S.

THE announcement of the death on October 8 of Sir Henry Head at his home near Reading at the age of seventy-nine closes the career of a great neurologist. He came of an old Quaker family, was educated at Charterhouse, and in 1880 was elected to a scholarship at Trinity College, Cambridge. In due course he graduated B.A. with a first class in physiology in the Natural Sciences Tripos. He then spent a period of two years at the German University of Prague and the University of Halle. His first paper was a contribution to *Pflügers Archiv* in 1887 on the action current of nerve, and from Hering's laboratory in Halle he published in 1889 a masterly paper on the whole question of the respiratory effects of the vagus nerve. He had himself devised a method of registration of respiration which was afterwards to become a standard method.

Head now proceeded to qualify in medicine, following study at University College Hospital, London. His M.D. thesis in 1892 was "On disturbance of sensation with especial reference to the pain of visceral disease" and was of outstanding merit. It led to the long series of investigations of disorders of sensation resulting from damage to, or disease of, the nervous system, with which his work is chiefly identified. His original study of pains referred from deep structures was followed by the elucidation of the pathology of herpes zoster (shingles), and from the pattern of the eruptions of that disease he was led to the delineation of the areas supplied by the various sensory nerve roots in man. This latter investigation, partly in collaboration with A. W. Campbell, was of great practical importance in the localization of nervous disease in medical practice, and secured him world-wide recognition. The proof of the astonishing accuracy of detail which he obtained was demonstrated by Foerster's mapping in 1933 by an entirely different method. In 1898 he was elected assistant physician to the London Hospital, and was occupied in hospital and private practice to the time of his retirement.

Head's attention was next turned to the disorders of sensation resulting from interruption of nerves to the skin. With Sherren and Rivers, in 1905 and 1908, he demonstrated the curious features of sensation at the border of an area deprived of supply by a cutaneous nerve. Here he established the existence of a zone, hitherto undescribed, where the threshold of sensation to touch, pain and temperature was profoundly altered, and discriminations of localization and intensity no longer possible. He established the existence and nature of sensations perceived through the deep nerves under skin which was completely deprived of sensation. He and Rivers described in detail and with great accuracy these changes in an experimental section of a nerve in Head's own arm.

These studies opened a whole chapter in neurology and were of great practical importance. The hypothesis by which Head accounted for these phenomena led to much discussion for many years and stimulated a great deal of investigation by others. The facts brought to light by the original investigation have been amply confirmed and little more has been added. Essentially, Head's hypothesis was that the zone of intermediate sensation represented a primitive 'protopathic' variety of sensation which he supposed to be evolutionally earlier than 'epicritic', highly discriminative qualities of sensation. His imaginative mind enlarged the conception in masterly fashion, adducing careful studies of many different aspects of sensation in man in support. The chief defect of this conception was the lack of any biological evidence of such evolution, and the failure of any subsequent confirmation that two entirely different systems of nerves existed. It is to-day more widely held that the differences are not so sharp and clear-cut as Head's methods of testing led him to believe, that more quantitative methods reveal a gradual transition, and that the qualities of the intermediate zone are the effect of the quantitative reduction of data conveyed by the nerves to the discriminative mechanism in the brain. However that may be, it is to be deplored that the discredit of Head's hypothesis should have detracted, as it certainly did, from the magnificence of his contribution to knowledge of sensation in the skin.

In 1906 Head published with Thompson studies on the conduction of sensation in the spinal cord, and again clearly defined principles which are an essential part of the practice of everyday neurological medicine. They plainly demonstrated the functions of the dorsal columns.

With Gordon Holmes in 1911 Head extended his investigations to the disorders of sensation resulting from damage to the cerebral cortex and other parts of the brain, and illuminated a whole field hitherto completely obscure. During the War of 1914–18 he gave up his private practice and lived at hospital, not only giving the benefit of all his invaluable experience, but also making new investigations, notably on the disturbances of speech resulting from localized damage to the brain, and, with Riddoch, on some of the effects of damage to the spinal cord.

Head's extensive painstaking study of disorders of speech was finally completed by the publication of two volumes on "Aphasia and Kindred Disorders of Speech" in 1926. His contribution in this field had less immediate practical importance than his earlier works, but was highly original and brought new emphasis on the complex interrelation between disorders of language and intellect. He freed the terminology of the subject from its implication of minutely localized sensory and motor components, and demonstrated the similarity in type of disturbance of both comprehension and expression from any particular damage.

In his interpretation of the late changes of spinal reflexes from spinal injury, Head invoked reversion to a hypothetical primitive state in explanation of the final disintegrated state, the 'mass reflex', again eliciting the criticism levelled against his views of 'primitive' sensation in the skin. Nevertheless, as with all his other investigations, he brought new light and abundant stimulus to the problem, and at a bound advanced the whole subject from the previous confusion of ideas and crudity of method of exploration then still prevailing in most fields of investigation of disordered physiology at the bedside.

These form Head's chief contributions, a truly noble series which placed him for all time among the small band of British neurologists—Gowers, Hughlings Jackson, Ferrier, and Sherrington, who adorn that period of remarkable advance in all medicine, 1890–1920. His other writings include a volume of verse published in 1919. He received many honours, was elected a fellow of the Royal Society in 1899, and was knighted in 1927. A man of great patience, humility and profound learning, he was fated to endure great physical discomfort and incapacity from a slowly progressive nervous disease for the last twenty years, made heavier in the last eighteen months by the loss of his gifted and devoted wife.

D. Denny-Brown.

We regret to announce the following deaths:

Mr. M. B. Buxton, president of the Institution of Structural Engineers, on October 14.

Dr. Myron Mathisson, formerly of the University of Warsaw, who during the past year has been doing mathematical research work at Cambridge, aged forty-three.

Dr. C. H. Merz, a well-known consulting electrical engineer, aged sixty-six.

Mr. E. L. Rhead, formerly lecturer in metallurgy in the College of Technology, Manchester, on October 19, aged seventy-six years.

NEWS AND VIEWS

Greece

With the open attack on Greece by Italy, a new phase of the War, centring on the eastern end of the Mediterranean, would seem to have opened. The long threatened invasion of Great Britain having been postponed—or found still-born—the Axis partners have turned to the Mediterranean, towards which the dominant member has already made an approach by taking over Rumania, in their search for a quick and resounding victory. However deeply we may regret that still another country is to be exposed to all the horror and destruction of modern war, it has become increasingly clear in the course of the events of recent months that the whole world is becoming more and more closely involved in the struggle on one side or the other, while for those people who aspire to maintain their freedom and preserve the liberty of the individual, there is no hope save in fighting on the side of those who champion the ideals of democracy.

The attack on Greece has long been foreshadowed in Italy's attitude in respect of 'incidents' on the Albanian frontier, and it is evident that steps had been taken to deal with the situation when occasion arose. Already the Greek people have experienced something of the nature of attack from the air. The proclamation of Athens as an 'open city' should serve, if respected, to preserve a city rich in archæological and classical associations. It would plumb the depths of irony if, in the struggle to preserve what is best and noblest in modern civilization, the relics of the source from which so much of it has sprung should be irretrievably destroyed.

Camouflage

The many absurdities in methods adopted for camouflage and the lack of co-ordination of research on this all-important subject formed the basis of an article in Nature of June 22, p. 949. However, some progress, though somewhat tardy, has been made, and indications of this were given by "J. S. H." in Nature of October 12, p. 482, after a visit to the headquarters of the Civil Defence Camouflage Organization. But such progress has been made by technicians in practical research; there has been little indication of improvements in co-ordination of such research, and collaboration with the military and other authorities in its application. We are therefore pleased to note that such is on the way, as shown in the fourteenth report of the Select Committee on National Expenditure (H.M. Stationery Office, price 2*d.*) The committee received a report from its sub-committee on home defence services and adopted it with an amendment as its report.

Among the recommendations made are the following: The four existing camouflage departments should be united in a single organization with its own research staff and administered by the Ministry of Home Security. Greater use should be made of the experience and knowledge of the non-departmental members of the Camouflage Committee than has been made in the past. Departments and industrial undertakings of the kind which are required to be camouflaged should, when considering plans for buildings, be under an obligation to consult the central camouflage organization proposed.

Camouflage officers required for the fighting services should be supplied by the proposed camouflage organization. Serving officers required for camouflage duties should be seconded to it for training. The sub-committee states that the Ministry of Supply and the Admiralty have no research staff of their own and rely largely on the Ministry of Home Security's establishment. The sub-committee does not regard this as satisfactory. Recalling that two members who have great practical knowledge resigned from the Advisory Committee on Camouflage, the sub-committee is unable to acquit the camouflage departments of a certain degree of neglect of the knowledge and research placed at its disposal by members of the committee (see Nature of June 22, p. 949). A new committee was formed afterwards.

The testimony of departmental witnesses with the longest experience of camouflage of all kinds was emphatic that specimens of camouflage of fortified posts throughout the country are absurd and cannot be regarded as camouflage at all. The responsibility for these works rests with the Home Forces and the staff of camouflage officers attached to corps and divisions. The sub-committee attributes such errors to the hitherto insufficient number of these officers. It learns, however, that the number has recently been increased. Cases have been brought to the notice of the sub-committee where private practitioners have undertaken the camouflage of industrial premises. Some of these attempts have been futile and might be dangerous. The sub-committee learns with satisfaction that most of these private firms have gone out of existence since the beginning of the War. An Admiralty witness informed the sub-committee that camouflage of ships at sea has been abandoned. In its conclusion, the sub-committee says that the defence of this country so far as camouflage is concerned is a single problem. All schemes of camouflage should be considered as part of a general picture.

Medicine in War-time

Owing to the War, many medical men are cut off from access to journals dealing with their special subjects and from all foreign periodicals. Changed conditions of war may give rise to new problems. The Medical Research Council has therefore undertaken to issue a *Bulletin of War Medicine*, containing abstracts of papers from both British and foreign sources. This *Bulletin* is to supply information, not only to specialists, but also to practising medical officers. It is intended to cover all branches of medicine that can apply to war conditions, but not those concerned more intimately with tropical diseases, or matters of purely public health interest, abstracts of which are already available in the *Bulletin of Tropical Diseases* and *Bulletin of Hygiene*. The work of searching literature and abstracting suitable papers has been entrusted to the staff of the Bureau of Hygiene and Tropical Diseases.

The first number of the new *Bulletin*, which is dated September, contains sixty-three papers. Twelve deal with surgery of special regions, nine with general diseases and eight with aviation medicine. Among the subjects dealt with are blood transfusion (eleven abstracts), shock (five abstracts), the use of sulphanilamide and similar preparations (six abstracts) and civil evacuation (five abstracts). Two abstracts only deal with food in war-time. The abstracts are thorough; in many cases it would be unnecessary for the reader to refer to the original article for further details. It is proposed to issue the *Bulletin* every two months; besides being distributed to medical officers of the fighting services and the emergency medical service, the *Bulletin* is being placed on sale (London: H.M. Stationery Office 2*s*. 6*d*. net.).

Mr. J. B. Priestley's "Postcripts"

It is given to few to provide such a complete interpretation of the spirit of Great Britain as Mr. J. B. Priestley has achieved in the 'postscripts' which he has broadcast regularly during recent months. His has been the authentic voice of the country, whether in expressing the courage, resolution and good humour with which the people are meeting the challenge and dangers that confront us, or in voicing the passionate desire and determination to be found in all sections of the population that the sacrifices now being made shall issue in a new order, to be shared by men of good will everywhere, from which the grosser injustices and inequalities of the past have been eliminated. Scientific workers will share to the full the general regret at Mr. Priestley's announcement of the termination of these broadcasts, much as they will respect the reasons which have led him to that decision. All who have enjoyed these broadcasts can best show their appreciation by the wholeheartedness with which they address themselves to the tasks of reconstruction already to hand, the extent and urgency of which has been the theme of many recent articles in Nature.

Fitness in Industry

Fitness in industry is of primary importance to the nation, and nothing that will contribute to the good health and high morale of industrial workers should be neglected. Not the least important of its applications is the provision of the tonic effects of natural sunshine by artificial means (welfare solaria). A letter recently communicated to the Press by Mr. F. J. Pascoe, director of British Timken Ltd., describes some of the activities of his company in this direction. The Company's welfare ideas are based on years of experiment, and are not a product of present emergency conditions. The blackout, the seven-day week and night shifts deprive workers of sunlight. The Timken works produce artificial sunlight treatment. These works are large, and elaborate arrangements are justified. Suitable equipment is attainable comparatively cheaply for smaller works, but treatment must be regular and carried out under qualified supervision and in accordance with carefully prepared plans. The Timken Co. has a medical man in frequent attendance, and treatment is administered by a qualified nurse. This treatment has been found to be definitely beneficial to the workers. Short-wave therapy apparatus is used for treating septic wounds and skin troubles met with in the industry. For a small works this apparatus is somewhat costly, but the results obtained in a relatively short time are astonishing. Treatment should be given under medical supervision.

Eyesight is of vital importance in quick and accurate production. Free eyesight tests by the visiting doctor costs the Company little and is a help to the workers. Footwear is a problem. A girl worker standing most of the day on concrete floors in thin high-heeled shoes will take very serious toll of her staying power. This is a most neglected point; workers' footwear should be stout and in good repair. Rubber soles, except in certain types of factories, should be prohibited. The Timken Co. purchases wooden shoes (sabots) which the girls buy at half their cost to the Company. Smoking is allowed. Some works cannot do this, but where it is allowable it does help. One very strict rule, rigidly enforced, is that there must be no smoking in the half hour before people knock off; the reason for this is that fires caused by cigarette ends nearly always show within that time. Music in working hours is beneficial. The Company has had long experience of this, and broadcasts records in two sessions each day to quiet shops where work is of a monotonous nature. One class of music is given in each session—waltzes or marches; mixing the different classes of music upsets rhythm. Vocal records are never broadcast; light classical music is broadcast at meal times. For A.R.P. shelters stirring choruses are used. Works canteens are sometimes dingy. There is no reason for this. Paint is cheap and pleasing and decorative ideas are even cheaper. A woman's ideas will soon brighten the canteen. Preparation and choice of food for the workers should be as carefully planned as the production in the factory.

Control of Wild Life

For various reasons in the national interest, a number of official decisions have recently been made to limit the numbers of certain species of British fauna, which in some cases will check the results of protective legislature and private efforts at conservation in the past decade. The Air Ministry has authorized the taking or the destruction of peregrine falcons or their eggs in certain areas including Ayrshire and Dumfriesshire in Scotland and a ten-mile deep area along the Kent and Sussex coasts in England, because of the risk of these falcons attacking carrier pigeons. A deer controller has been appointed to reduce the numbers of wild red deer in Lakeland and north Lancashire, where in recent years these animals have spread from the forest of Martindale and as a result of crossbreds with escaped hinds carted for hunting. A deer controller was appointed for a similar purpose with the Scottish deer forests last year. An Order prohibiting the use of any land for the artificial hatching and rearing of pheasants except under licence—which is chiefly granted to certain game farms where the birds are to be reared for food—does not include partridge and wild duck, but a recent inquiry by the Gamekeepers' Association to the Ministry of Agriculture elicited the information that an Order is contemplated prohibiting the rearing of all game for sporting purposes, and another prohibiting the use of feeding stuffs to game birds, except under licence. For the time being, this means the end of artificial encouragement of game birds and the complicated upsetting of the balance of Nature which it entails in the countryside.

Dr. Christian Fenger

Dr. Christian Fenger, the first teacher of pathology in the Middle West and an eminent Chicago surgeon, was born on November 2, 1840, at Copenhagen, where he qualified in 1876. He then went to Egypt, where he became a member of the Sanitary Council and surgeon to the Khalifa in the Cairo district. In the following year he settled in Chicago, where he was appointed consulting surgeon to the Cook County Hospital and lecturer on surgery to the College of Physicians and Surgeons. His post-mortem examinations and surgical clinics henceforward became the centre of postgraduate instruction in Chicago. During the thirty years of his professional life he contributed more than eighty articles to surgical literature, his chief work being connected with cancer of the stomach, hernia of the brain, the ball-valve action of floating gall-stones, the operative treatment of cerebral abscesses and the surgery of the ureters and bile-ducts. He died on March 7, 1902. After his death the Christian Fenger Memorial Association was founded under the auspices of the Chicago Medical Society and published his collected works in two large volumes.

All-Electric Laundry

St Gabriel's Laundry, of which an illustrated account is given in the *Electrical Review* of October 11, is the first all-electric establishment of its kind in Eire. It serves Athlone and the surrounding region and belongs to Sisters of Mercy, one of whose main activities is the domestic training of girls. Originally all the work was done by hand, water being carried from the River Shannon. In 1907, a steam engine and washing machines were installed. Recently, the laundry has been completely electrified, resulting in greater cleanliness and better working conditions. Belt-drive and shafting have been eliminated, and there has been a consequent all-round improvement. In the new wash-house there are three large washing machines supplied directly with water at 180–200° F., as required, from two 700-gallon storage electric water-heaters which feed the washing machine, rinsing troughs, soap boilers, starch emulsifier, etc. The water is heated at night so as to get the advantage of the cheap rate.

The utilization of electricity has greatly simplified the blueing and starching process. In the case of most of the work coming to the laundry, washing, blueing and starching processes are carried out without the clothes leaving the washing machine. Four methods of drying are available, three of them electrical. The drying apparatus is divided into three groups and consists of two large hydro-extractors, a drying tumbler and a drying room. The ironing room is airy, spacious, and lighted by large windows. The electric lighting is specially designed to give perfect illumination on the work and prevent glare in the eyes of the workers. Electric hand-operated irons are installed on both sides of two long tables adequately lighted from both natural and electrical sources. There are also a collar-finishing table, two large press ironers for coats, suits, etc., and one small press ironer. A calendering machine for flat work is notable by the absence of steam. The bed of the machine is electrically heated and the roller hollow and perforated. The steam which would otherwise rise when the damp articles are heated enters the roller and is drawn off by a fan through an exhaust pipe to the outside of the building.

The Dionne Quintuplets

An editorial in the May issue of the *Statistical Bulletin* written on the occasion of the sixth birthday of the Dionne quintuplets on May 28 points out that never before has a similar event been recorded, as no other quintuplets have ever survived more than a few hours after birth. The five sisters, who were premature and tiny at birth, by living to the age of six have also surpassed the record of many normal full-born infants. Although about 94 per cent of all newborn baby girls live to the age of six, the chance of any group of five baby girls surviving to that age is appreciably smaller, namely, 75 per cent. At their present age each of the Dionne children has an even chance of living sixty-three years more. The editorial also points out that the Dionne quintuplets are fortunate not only in being born at a time when the knowledge of how to control sickness and death is being constantly extended, but even more so in having been attended by Dr. Dafoe, who used all the expedients of modern medical science on their behalf. As regards the special hazards to life and health facing the Dionne children in their coming year of life, the records of the Metropolitan Life Insurance Company show that accidents at the age of six are by far the greatest danger to both boys and girls. Next, but causing considerably less than half as many deaths, come influenza and pneumonia, closely followed by appendicitis, heart disease and tuberculosis.

A New Museum at Leicester

The opening on July 23, 1940, of the Chantry House and Newarke Houses, the former dating from 1512 and the latter a century later, as a regional museum, illustrates one successful method of preserving and using characteristic examples of local architecture (*Museums Journal*, 40, 173; 1940). More than a quarter of a century ago these houses were threatened with destruction with a view to the erection of factories in their place; but the intervention of a few public-spirited citizens and the interest of Leicester Corporation saved the site and buildings. The new museum, to be known as the Leicester and County Museum, is planned, according to the trust deed, "for the purpose of telling the story of the City and County of Leicester in ages past and illustrating its condition for the time being and exhibiting suggestions for its reform and improvement and the promotion and extension of artistic culture and scientific knowledge". The War has delayed the fulfilment of these projects, but a beginning has been made, and the exhibits of civic ceremonial relics, early pieces of Corporation plate, wearing apparel of the eighteenth and nineteenth centuries, military uniforms, and agricultural and domestic implements, indicate the lines on which development will proceed. At present only the ground floor is being used, but the hope is expressed that soon other parts of the buildings will contain their own special collections.

Comets

Harvard College Observatory Card 531 announces the discovery of Comet Whipple, 1933*f*, by Mr. L. E. Cunningham on September 1, at Oak Ridge. Photographs made through passing clouds with the 12-inch Metcalf refractor gave the following positions:

1940 U.T.	R.A. 1950·0 h m s	Dec.	Mag.	Diam.
Sept. 1·1486	22 34 08·1	−0° 15·9′	15·5	10″
1·1895	22 34 06·5	−0° 16·2′	15·1	

Perihelion passage would appear to be Jan. 22·464, 1941, which is about 0·23 day earlier than was predicted. The following ephemeris uses the corrected values of T, and gives small residuals for the above positions:

1940 U.T.	R.A. h m s	Dec.	r	Δ
Nov. 3	22 24 30	6° 50·0′	2·538	1·955
19	22 36 01	−6° 59·0′	2·519	2·129
Dec. 5	22 52 18	6° 26·2′	2·504	2·316
21	23 12 18	−5° 18·8′	2·494	2·505

Card 533 announces that Mr. Cunningham has found a comet on a photographic plate taken on September 5 with the 8-inch Ross telescope at Oak Ridge. The comet appears also on eleven patrol plates taken between August 25, and September 15 at Oak Ridge or Cambridge. The estimated magnitude on August 29 was 12·9, but plates taken on September 9 show that the comet is slightly brighter and had a strong nucleus and a tail 2′ long extending southward. Orbits have been computed by Cunningham and also by Maxwell and Bendler; the elements of the latter, which differ very little from those of Cunningham, are:

$$\begin{array}{lll} T & 1941\ \text{January}\ 18{\cdot}952 & \\ \omega & 197^\circ\ 29' & \left.\begin{array}{l}\\ \\ \\ \end{array}\right\}\ 1940{\cdot}0 \\ \Omega & 299\ \ 02 & \\ i & 51\ \ 24 & \\ q & 0{\cdot}3754 & \end{array}$$

Ephemeris 1940·0

		R.A. h m	Dec.	r	ϱ	Mag.
1940	Nov. 19	19 16	+35° 18′	1·44	1·32	8·1
,,	Dec. 21	19 18	20° 42′	0·76	0·85	3·1
1941	Jan. 22	19 59	−29° 06′	0·38	0·63	−2·1
,,	Feb. 23	20 52	46° 30′	0·93	1·40	5·4

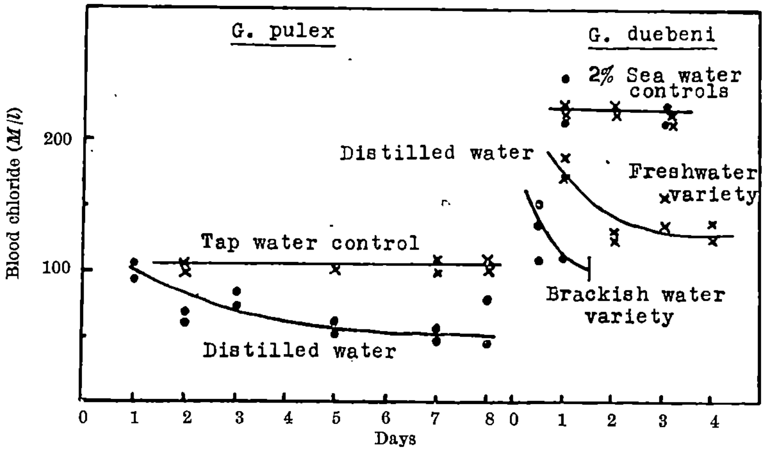
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Osmotic Regulation in Freshwater Animals

IT has recently been shown that both brackish- and fresh-water animals can actively absorb ions from the external medium against a considerable concentration gradient. Most fresh-water animals can do so from solutions as dilute as normal fresh-waters[1]. Krogh has suggested that in some cases, during periods of enforced starvation when salts are therefore not available from food, this mechanism is of survival value in maintaining the normal ionic and osmotic concentration of the blood[1]. In a recent paper[2] on the euryhaline crab *Carcinus mœnas*, Webb has gone further than this in assuming that "the active absorption of salts forms the basis of the osmoregulatory mechanism, not only in freshwater forms, but also in brackish water forms, including the euryhaline Crustacea". Without criticizing his conclusions as applied to Carcinus, we wish to point out that some experiments which we have carried out on brackish and freshwater species of Gammarus suggest that active absorption of ions from the medium is not of such universal importance as is implied in the above sentence.



The freshwater *Gammarus pulex* survived in a healthy condition when individuals were isolated and starved for at least eight days in glass-distilled water (changed twice daily). During the first two or three days there was a reduction in the blood chloride level, which thereafter remained relatively constant (see accompanying graph). Under these conditions, the possibility of absorption from the medium being excluded, *retention* of salts must be the predominant factor, for, as Webb points out, the possibility of the tissues possessing a store of chloride is extremely remote. Experiments with *Gammarus duebeni* lead to the same conclusion. This species is found in brackish water in most parts of Britain, but in some western districts it has invaded fresh-waters and it is the principal freshwater species of Ireland. Animals from brackish water rapidly lost chloride and died in distilled water, but the freshwater variety was resistant for at least four days (extent of experiment) and, after an initial loss, maintained a fairly constant blood chloride (see graph).

It is evident that an increase in the efficiency of a retention mechanism is mainly responsible for the adaptation of *G. duebeni* to fresh-water. The brackish water variety will live indefinitely, not only in 2 per cent sea water, but also in the same concentration of pure sodium chloride. Thus the power to retain ions other than Na^+ and Cl^- is well developed. Finally, we would quote experiments on the freshwater crustacean *Asellus aquaticus* (unpublished), which was unaffected by treatment for eight days with distilled water, and on the mosquito larva *Aëdes detritus*, which can live for long periods in distilled water, pure sodium chloride and glycerol solutions[3].

We have also found that *Gammarus pulex* and *G. duebeni* can actively absorb chloride from the external medium, but our experiments with distilled water show that this is not an essential part of the osmoregulatory mechanism. There is, in fact, no direct evidence that any freshwater animal is dependent upon salt absorption from the medium for the maintenance of an adequate concentration and composition of its blood.

We hope to publish these experiments in detail when we have the opportunity to extend and complete them.

L. C. BEADLE.

Department of Zoology,
University of Durham,
King's College,
Newcastle-on-Tyne.

J. B. CRAGG.

Department of Zoology,
University College of North Wales,
Bangor.

---

[1] Krogh, A., "Osmotic Regulation in Aquatic Animals" (Cambridge 1939).

[2] Webb, D. A., *Proc. Roy. Soc.*, B, **129**, 107 (1940).

[3] Beadle, L. C., *J. Exp. Biol.*, **16**, 346 (1939).

Golgi Apparatus as an Indicator of Secretory Activity in Pancreatic Islet Cells

Anselmino, Herold and Hoffmann[1,2] claimed in 1933 to have demonstrated a "pancreotropic" activity of pituitary extracts. Their claims rested on experiments in which a crude extract of the pituitary body was injected into young rats; in a few days an increase in the number of the islets of Langerhans was observed. The increase in islet tissue was ascribed to the action of a substance normally present in the pituitary gland. These observations were confirmed by several authors[3,4,5], and denied by others[6,7,8]. The majority of the investigators based their conclusions on anatomical and morphological variations of the pancreas islets, a somewhat subjective method of appreciating quantitative changes. The individual variations in the disposition and volume of the islets in the animals usually employed are unexpectedly large, and opinions based on inspection of microscopic sections, even serial sections, are unreliable. Richardson and Young[9] have applied a quantitative method of estimating the ratio of islet-acinar tissue for Wistar rats, and have found that the mean value of this ratio in animals treated with a saline extract of fresh pituitary gland is double that of normal rats, a difference which is statistically significant. Extracts prepared by the methods used by Anselmino had no such effect.

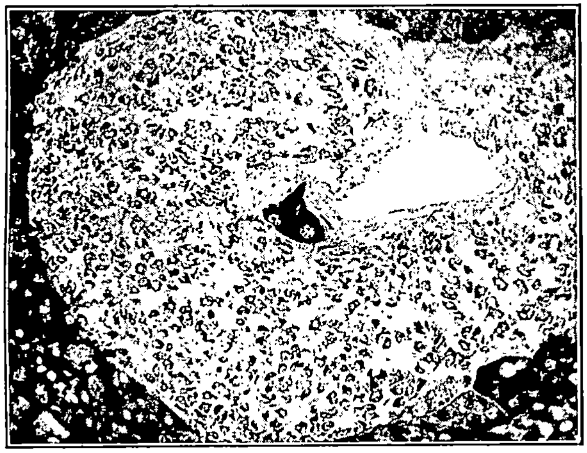


Fig. 1.

Pituitary hyperplasia accompanied by enlargement of the islets of Langerhans can be brought about by the prolonged action of œstrogenic substances[10]. Material suitable for the study of fine changes in the islet cells, changes which may be an index of endocrine activity, can thus be easily obtained. I am indebted to Dr. Gye for providing tissues of many mice of diverse age, of several strains and of both sexes, which had been treated with œstrogenic substances during variable periods of time, but always at least several months. Many of the animals examined presented pituitary enlargement with hæmorrhages; in others the hyperplasia was not so pronounced, but cytological modifications were always the same and suggested the existence of states of hyperfunction. Some of the animals bore malignant tumours, mainly mammary carcinoma.

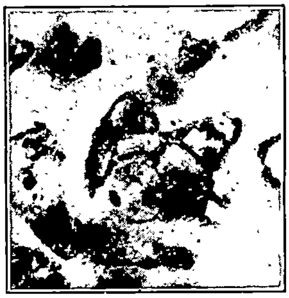


Fig. 2.

The cytological alteration found in these animals to which I wish to direct attention is the presence, in *every* cell of *all* the islets of Langerhans that have been examined, of a hypertrophic Golgi apparatus of a size never observed in the normal mouse. The normal Golgi apparatus consists of a number of threads in the vicinity of the nucleus, sometimes forming a tightly threaded network; in mice treated with œstrin it appears as dense thick regular threads in the form of a loose net with clearly visible spaces, spread all through the cytoplasm of the cell (Fig. 1). Whilst the normal structure resists our methods of impregnation, the altered structure is easily rendered visible. We employ the Cajal formol-uranium method and with this technique failure to demonstrate hypertrophy of the Golgi apparatus in every cell of an islet is exceptional.

The cells of islets are generally notably increased in size, and sometimes cells with two or more nuclei are found. In such cells the Golgi apparatus reaches its maximum size, enveloping the nuclei and presenting excellent conditions for detailed study (Fig. 2).

It is interesting to note that Ludford and Cramer[11] found that in pregnancy the Golgi apparatus of the cells of the islets is frequently enlarged and conspicuous.

The presence of giant islets with or without acinar residues and the apparent formation of new minute islets cannot be accepted as proof of absolute increase of the endocrine portion of the pancreas; but we have found with relative frequency a type of architectural alteration which seems to be the result of proliferation of the insular cells. Instead of a structure of chains of cubic or prismatic cells, more or less regularly disposed around the capillaries, there are islets, especially the larger ones, in which the cells

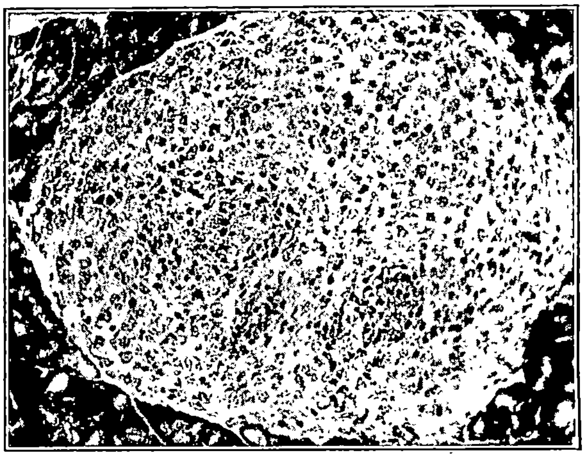


Fig. 3.

appear compressed and elongated by pressure of neighbouring cells, with nuclei ovoid in shape, homogeneous and intensely stainable. The disposition *en tourbillon* of the cells can be clearly appreciated when the section corresponds to a zone in which only a part of an islet seems to be affected, the nodules being especially shown up by their nuclear density from the tissue that is normal (Fig. 3).

Griffiths and Young[12] have demonstrated an increase in the insulin content of the pancreas of rats treated with œstrogenic substances. We think that the modifications briefly described above represent the histological basis of functional hyperactivity dependent upon excessive pituitary stimulation.

E. Vazquez-Lopez.

Imperial Cancer Research Fund,
Burtonhole Lane,
The Ridgeway,
Mill Hill,
London, N.W.7.
Oct. 4.

[1] Anselmino, K. J., Herold, L., and Hoffmann, F., *Klin. Wschr.*, **12**, 1245-1247 (1933).

[2] Anselmino, K. J., Herold, L., and Hoffmann, F., *Z. deutsch. ges. exp. Med.*, **97**, 329-335 (1935).

[3] Bierring, K., *Bull. Hist. Tech. micr.*, **11**, 297-301 (1934).

[4] Chrzanwski, B., and Grzycks, S. J., *Klin. Wschr.*, **16**, 488–490 (1937).

[5] Fichera, G., *Pathologica*, **30**, 286-290 (1938).

[6] Elmer, A. W., Giedosz, B., and Scheps, M., *C.R. Soc. Biol.*, **124**, 823–826 (1937).

[7] Santo, E., *Z. deutsch. ges. exp. Med.*, **102**, 390–406 (1938).

[8] Wolf, R., *C.R. Soc. Biol.*, **131**, 315-317 (1939).

[9] Richardson, R. C., and Young, F. G., *J. Physiol.*, **91**, 352-364 (1937).

[10] Cramer, W., and Horning, E. S., *Lancet*, **1**, 247-249 (1936).

[11] Ludford, R. J., and Cramer, W., *Proc. Roy. Soc.*, B, **101**, 16–24 (1927).

[12] Griffiths, M., and Young, F. G., Nature, **146**, 266-267 (1940).

Biological Effects of High-frequency and Magnetic Fields

Since diathermy first became a generally recognized method of treatment and especially after short-wave therapy was universally accepted, the controversy as to whether the heat effects alone account for the biological effects has not ceased. No other physical effect but heat has, however, up to the present been proved to exist while high-frequency currents are applied.

In the course of more than a year's work with an 'Inductotherm' short-wave diathermy apparatus it has become, by clinical observation, obvious to me that the magnetic field produced as well as the electric field was of some effect. An investigation of the effect of magnetic fields of different kind showed that small differences of potential and actual electric currents were produced inside biological objects very much after the principle of a dynamo, the biological object acting as the rotor.

The application of a concentrated magnetic field between the narrowly tapered poles of a D.C. magnet produces in a glass tube of 0·5 cm. diameter electrical potential differences if a salt solution or blood is pumped through it. With a D.C. magnet of 5,000 gauss and a velocity of flow of a salt solution of 60 cm. per second, potential differences of about 2 millivolt could be produced. This is well within the range of biological currents of the heart or the brain.

In the case of a D.C. magnet the production of electric currents within the tissues depends on the blood flow with the pulse. With A.C. magnets the changing of the direction of the field adds to the production of these currents. With high-frequency currents the magnetic field alternates so quickly, that the movement of a stream of liquid is no longer needed, and electric currents are produced also in capillary and lymphatic areas, even in non-vascularized tissues.

While with D.C. magnets electric currents of a certain direction can be produced, electric currents produced by A.C. and high-frequency magnetic fields cannot be directed, but originate more or less in the form of eddy currents. But the possibility of localizing diathermy and ultradiathermy makes it possible to concentrate the production of these electric currents in circumscribed areas or organs.

It seems certain that these magnetically produced electric currents play a part in the effects of diathermy treatments. They probably account for the immediate relief of pain in some cases, long before any measurable rise of temperature in the tissue occurs. The production of electric currents inside the tissue differs from the ordinary external application of electricity exactly in the same way as the production of heat in the tissue by diathermy differs from externally applied heat.

Biological and clinical investigations along these lines have been started.

K. F. Nagelschmidt.

Edgecoombe,
The Avenue,
Bury New Road,
Manchester.
Sept. 30.

The Existing Coelacanth Fish, Latimeria

In my review of Prof. J. L. B. Smith's account of the existing Coelacanth fish, Latimeria (Nature, July 13, 1940, p. 53), I remarked that the fins appeared to agree with those of the fossil Coelacanths in all respects except the considerable extension backwards of the membrane of the anterior dorsal fin.

According to the annual report of the South African Museum for 1939, the dried fish has been prepared anew with great skill by the Museum's taxidermist, Mr. James Drury, and it is now evident that such an extension of the anterior dorsal was deceptive. All the fins of Latimeria, therefore, are of the normal Coelacanth type. As shown by the photograph published in the report, Mr. Drury has made an excellent restored cast of the fish, of which it will be possible to distribute copies. There seems to be only one small feature open to criticism—the bifurcation of the rays in the hinder portion of the pectoral fin. All the fin rays hitherto observed in Coelacanths are simple rods, and those preserved in the specimen of Latimeria are likewise without any distal sub-division.

A. Smith Woodward.

Hill Place,
Haywards Heath,
Sussex.

RESEARCH ITEMS

Pueblo Indian Irrigation Systems

An attempt to reconstruct the methods of irrigation developed by the Pueblo Indians, the earliest agriculturists among the indigenous inhabitants of the United States, in cultivating the arid lands of the south-west in the period preceding the Spanish conquest, has been made by Guy E. Stewart (*Scientific Monthly*, **51**; 1940) on the evidence mainly of an examination of ancient sites of cultivation, more especially the famous Mesa Verde, where early abandonment places Old World influence out of the question. Here the Far View group of ruins is near the upper end of an unusually complete unit of flood water irrigation which begins from a circular reservoir for flood water now known as Mummy Lake. This supplied cornfields and check dam areas along the Mesa top by a primitive ditch. Deposits of silt 10 ft. deep in the Lake indicate use over a long period. Evidence along the ditch indicated where water might have been turned off to the cornfields and where additional water might have been picked up. The cross-section of the ditch is broad and flat, and the ditch has a remarkably uniform grade. Two areas of garden check dams were located adjacent to the flood water ditch. The check dam type of village gardens is a characteristic of agriculture at Mesa Verde. They vary widely in size, ranging from 6 ft. × 9 ft. to 35–40 ft. wide with a cultivable breadth of 10–15 ft. All have a definite type of construction with the corner of the dam well toed in to the bank to give stability. Most of these were built on rock ledges. The entire length of the flood water supply ditch from Mummy Lake to the lower check dam area measures approximately four miles. The purpose of the system was evidently water conservation. Evidence of similar or analogous systems has been examined on the Rio Grande and Gila Rivers.

Infra-Red Transmission of the Human Body

C. Hawley Cartwright, John Daniel and Alex Petrauskas, of the Massachusetts Institute of Technology, described experimental research on this subject in a paper at the annual meeting of the U.S. National Academy of Sciences during April 22–23. The percentage reflection and transmission of a human cheek was measured as a function of wave-length in the visible and infra-red spectra. Absolute values were obtained to 12,000 A. by using a special photocell and an integrating sphere, for collecting all the light. The reflection of the cheek reaches a maximum of about 50 per cent in the visible red and gradually decreases for longer wave-lengths. The cheek (10 mm. thick) is opaque below 6050 A. and increases its transmission linearly to about 2 per cent of that entering the skin at 7000 A. Between 7000 A. and the water absorption band at 10,000 A., the transmission is rather uniform. Beyond 10,000 A., the transmission rises, reaches a maximum value of about 3 per cent at 11,000 A. and decreases to zero beyond 13,500 A., due to the water absorption. Using as a control a bearable discomfort on the outside of the cheek, measurements of the temperature rise inside the mouth were made using various sources of radiation. The best of these was a tungsten lamp with a water filter. An increase in temperature of 3° F. was obtained inside the cheek without external discomfort.

Indian Copepods

Dr. F. Kiefer, in a handsome monograph, has described the copepods collected by the Yale North India Expedition, which made a speciality of the study of the lakes, tanks, ponds and pools in the area investigated (Freilebende Ruderfusskrebse (Crustacea, Copepoda) aus Nordwest und Südindien (Pandschab, Kaschmir, Ladak, Nilgirigebirge), by Friedrich Kiefer, Karlsruhe (Baden). Scientific Results of the Yale North India Expedition. Biological Report No. 19. *Mem. Indian Mus.*, **13**, Part 2; 1939). The bulk of the work is confined to systematics and descriptions of the species with careful drawings, but there is included a detailed account of their ecology and geography and a list of the free-swimming freshwater copepods of India. A key is given of the males and females of the species of the genus Neodiaptomus Kiefer (six in all). 27 species of copepods were collected, 10 of which are new. Most of them are from altitudes ranging from 1,000 to 5,000 metres. Eucyclops (a separate genus according to Kiefer, but regarded as a sub-genus by Gurney and others) has a world-wide distribution. In the present work three species are recorded. A recent contribution to the study of these forms is by K. Lindberg (Cyclopides (Crustacés, Copépodes) de l'Inde. III. Une Revision des représentante indiens du sous-genre *Eucyclops* s.str. (Groups *serrulatus*.) *Rec. Indian Mus.*, **41**, Part 4; 1939).

Peculiar Water Relations of a Diatom

In a recent publication D. Bhatia (*Proc. Roy. Soc. Edin.*, 60, 245; 1940) has continued the study initiated by Gross of the remarkable water relationships of the diatom *Ditylum Brightwelli* (West). This diatom plasmolyses rapidly in isotonic and hypotonic sodium chloride and sugar solutions and also, more slowly, in sea water in the dark. Weak concentrations of urethrane produce effects similar to those produced in the absence of light, namely, delayed plasmolysis and immediate recovery on return to normal conditions. Inhibition of oxidative processes by treatment either with cyanides or sulphides causes immediate plasmolysis, and the subsequent recovery on return to normal is delayed if the oxygen inhibition is prolonged beyond 8–10 hours. Similar effects are obtained in 'reduced' sea water. Absence of light is without effect in this relation of oxygen deficiency to plasmolysis. The effects of alcohols do not resemble those of light or oxygen deficiency, for plasmolysis is incomplete or else the effects are destructive. Their effectiveness follows the series methyl < ethyl < butyl < amyl < octyl. Rapidly formed 'artificial' resisting spores (plasmolysed cells) recover partially in the absence of light before beginning to shrink again, as also do spores under anaerobic conditions. 'Exhausted' resting spores (plasmolysed in the dark) never recover. Resting spores formed under oxygen deficiency recover partly if oxidation is restored but assimilation prevented. It is suggested that under normal conditions turgor is maintained by secretion of cell sap at the expense of energy released by respiration. An energy-precursor, produced during assimilation, is also necessary. With the inhibition of assimilation (darkness or urethrane) this energy-precursor is reduced, and after using up its store in 15–20 hours the cell begins to plasmolyse. Inhibition of oxidation, on the other hand, causes immediate plasmolysis owing to the withdrawal of the necessary energy. Recovery consists of two stages: an initial anaerobic process dependent on the presence of energy-precursor and connected with change in state rather than volume, and the subsequent complete recovery which depends on the presence of oxidative processes.

Unequal Breaks in Sister Chromatids

M. Demerec and E. Sutton (*Proc. Nat. Acad. Sci.*, 26, 532–536; 1940) show that, as a result of X-rays, one of the two sister chromatids may be broken at one point, while both chromatids are broken at a second point in the same chromosome. Females of a strain of *Drosophila melanogaster* which were heterozygous for *dm* had diminutive bristles, and some showed mosaic spots covered with wild type wing bristles. Cytological observation confirmed the supposition that a chromosome rearrangement involving *dm* and heterochromatin had taken place. Further investigation showed that one chromatid of the *X*-chromosome has a deficiency involving changes of several known gene loci, while a slightly shorter segment has been translocated from the sister chromatid to the fourth chromosome. It is believed that one electron hit produced all the changes noticed.

Aleutian Islands Earthquake

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of August 22 at 3h. 27m. 18s. G.M.T. from reports received from twenty seismographic observatories. The epicentre appears to have been at lat. 51·9° N., long. 164·9° W., which is in the Pacific Ocean to the south of Unimak Island in the Aleutian Islands group. This is a continuation of the seismic activity previously reported in the Aleutian Islands, though it is somewhat to the east of other recent earthquakes in this neighbourhood. An earthquake was recorded at Kew Observatory on August 22 at 3h. 39m. 3s. G.M.T., attaining a ground amplitude of 84 μ at Kew, and provisionally estimated at Kew to have taken place 8640 km. away.

Reaction between Chlorine and Nitric Oxide

THE combination of nitric oxide with chlorine: $2NO + Cl_2 = 2NOCl$, has always been considered a homogeneous termolecular reaction, but E. M. Stoddart (*J. Chem. Soc.*, 823; 1940) finds that it can be considerably influenced by surface conditions and hence concludes that it is really heterogeneous in character. The nitrosyl chloride, by adsorption on the walls of the vessel, can inhibit the reaction so that it ceases altogether. The kinetic experiments can be interpreted by assuming that the nitric oxide associates to $(NO)_2$ on the surface, and the complex may or may not undergo homogeneous reaction with chlorine according to whether the complex molecule has or has not been stabilized by the surface of the reaction vessel, the latter being assumed to be composed of active and inactive portions. The unusual assumption that the surface and gas phase are not in equilibrium, is also necessary to explain the results.

Scale Formation in Electric Water-Heaters

IN an article on electric water-heaters by J. F. E. Edgell, consumer's engineer to the City of Gloucester, in the *Electrical Times* of October 3, it is stated that the storage capacity of a 1½ gallon cylinder can be reduced by scale to a ¾ gallon capacity in a period of service of only one year. Illustrations are given of severe practical examples of scaling. Last July, J. I. Bernard read a paper to the Institution of Electrical Engineers on this subject, in the discussion of which Mr. Edgell took part; the paper and discussion are published in the October issue of the *Journal* of the Institution. Mr. Bernard referred to the usual classification of water as hard and soft, the former being distinguished by a small content of lime which is deposited in the form of 'scale' on heating. Soft water, on the other hand, frequently contains traces of carbonic acid, and when heat is applied it is liable to corrode base metals, such as iron and lead. Hence the prevalent use of copper for hot-water storage vessels in soft-water districts, in contrast to the use of iron tanks where hard water is encountered. Analyses of scale deposits show a variety of salts, principally calcium carbonate and also calcium sulphate, magnesium hydrate, etc., most of which are not precipitated until a temperature of 180° F. is reached. Mr. Edgell stated that while this is most probably correct for most salts, a lot of precipitation occurs at a much lower temperature. He submitted also that the temperature at which liberation of the carbon dioxide gas occurs is governed to a large extent by the turbulence of the liquid. The liberation of carbon dioxide is, of course, the root cause of scale formation.

Theory of Nuclear Resonances

G. BREIT, of the University of Wisconsin, discussed this subject in a paper at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. He pointed out that pronounced resonances are observed in a number of nuclear reactions, and it is customary to interpret these as due to the formation of temporarily stable states of the compound nucleus. While this qualitative picture is applicable in many cases, its quantitative validity is doubtful. Some limitations of the 'dispersion' treatment which become apparent when the wave equation is treated accurately are as follows: (*a*) Coupling through the field changes the position of the levels in addition to the Dirac frequency shift. (*b*) The same energy level should not show peaks at the same energy in different reactions. Shifts of the order of the level width are expected. Sufficient conditions for the absence of shifts are known. (*c*) The combined effect of several levels shows itself in interference in both the numerator and denominator of a fraction. (*d*) Neither the regular nor the irregular (F, G) solutions of the radial wave equation are universally applicable to the computation of mean lives of compound states. Green's function for two and more dimensional separable problems is used for an estimate of competitive effects of nuclear excitation. Additional justification is given to the form of dispersion theory worked out by Wigner and Breit.

EVACUATION OF THE VERY YOUNG

THE further report on evacuation (Evacuation: the Under Fives. August 1940) by the Evacuation Committee of the Association of Architects, Surveyors and Technical Assistants deserves wider attention than it appears to have yet received, particularly in view of the determined policy of evacuation urged by Lord Horder and the statement of Mr. Malcolm MacDonald, Minister of Health, to the House of Commons on October 17. Mothers and children, he said, are leaving London at the rate of several thousands a day. Already about 489,000 school children or some 56 per cent of the school children in the London evacuation areas had left, and 300,000 out of 500,000 in the L.C.C. area had gone to reception areas.

This movement, which gains part of its present importance by the indirect consequence of reducing the demand for deep shelter and the risk of overcrowding, removes to safer areas some of those most liable to dangers to health which attend nights in deep shelters, apart from the special risks of overcrowding. From every point of view their removal out of London is to the good, but as was shown in the report to the Fabian Society edited by Richard Padley and Margaret Cole entitled "Evacuation Survey" (see NATURE, October 5, p. 439) the evacuation of very young children presents special difficulties and problems. The present report makes a very definite contribution to an acute problem, and adoption of its recommendations should prevent a number of the mistakes made in the earlier evacuation being repeated as well as offer safeguards for the health of those going to the reception areas.

The report points out that in August some 750,000 babies, belonging to about 500,000 mothers, were in dangerous areas, as well as more than a million children between two and five. Any evacuation scheme to the relatively safe areas must be based on a thorough re-zoning of the British Isles by competent military and civil authorities taking into account both types of dangerous area. The failure of the first scheme is attributed to lack of consideration for the psychology of family life, coupled with a lax definition of safety areas, the absence of satisfactory arrangements to accommodate mothers with young children, and the placing of the responsibility for carrying out the scheme on local authorities who were not sufficiently interested or qualified. The principle of evacuation was not at fault. Failure of the general scheme as a whole was due to insufficient understanding of the problems which are involved and refusal to deal with the many deficiencies that appeared by financing a workable scheme.

The scheme put forward in this report is founded on the belief that no baby under two years old should be sent away from its mother unless in special circumstances a close and suitable friend can be found to act continuously as a foster-mother. Most two- to five-year olds can be successfully separated from their parents if a mother substitute looks after them in small groups. Groups of four or five children may be joined together in school units of not more than twenty children.

An evacuation allowance should be available for mothers of babies under two or of several children under five, so that they have a free choice of whether to evacuate or not. Evacuated mothers must have independence in managing their own families and must be fully used in caring for other unaccompanied children. Visits by husbands must be possible, and for this purpose reduced fares and overnight accommodation must be provided. Temporary day nurseries must be set up for all children under five in the dangerous areas as part of the organization for evacuation and to establish confidence in it. Welfare centres and young people's hostels will also be required for members of the family who are left behind. Local authorities in the dangerous areas should be empowered to act equally with those of the reception areas in initiating evacuation arrangements.

The second essential is proper accommodation in the reception areas. The only way of evacuating mothers and young children immediately is into group billets, and accordingly it is proposed that the large country houses in safe areas should be immediately requisitioned for the reception of three quarters of a million mothers and children under five. A building programme is also essential. This should be carried out in stages; first, making all suitable existing buildings usable; second, providing sleeping and feeding accommodation; and third, the provision of day crèches, playrooms and staff accommodation. The report suggests that less alteration than is often supposed will be required for the large houses. The extra sleeping and feeding accommodation to be constructed includes family cottages and hostels for mothers and babies, and sleeping and feeding sections of residential nursery schools for children of two to five years.

This building programme avoids, to a great extent, using materials which are imported or urgently wanted for war purposes, and skilled site labour. An adequate quota of materials and labour must, however, be made available by the Government. The whole cost of the scheme is estimated at £100-£140 millions, and this expenditure would have important results in morale and organization during the War as well as provide permanent assets to the community.

The second part of the report gives details of the recommended planning standards for the new buildings proposed with detailed suggestions for economy of available materials in construction and sketches of typical designs for the alteration of existing country houses and the erection of family cottages for two mothers and children, a hostel for twelve mothers and children, a day crèche for twenty children under two years old and a residential nursery school for forty children in two separate groups with a matron, two assistant teachers, eight foster mothers and a cook.

The report appears to represent exactly that type of positive criticism for which Mr. Bevin recently appealed and indicates the opportunity which still remains for retrieving past mistakes and profiting by them to build better.

TRANSFORMER INSULATING OILS

A USEFUL paper on transformer insulating oils was read by B. Calvert before the Sheffield Section of the Graduates and Students of the Institution of Electrical Engineers last year and is now printed in their *Quarterly Journal.*

Mr. Calvert points out that Faraday appears to have been the first to examine oily liquids for their insulating properties. The first commercial use made of his discoveries was in connexion with telegraph cables, for which rosin oil was employed. With alternating current transformers, the high temperatures used in practice made rosin oils unsuitable because of the formation of sludge and rapid evaporation of the oil. Thus modern transformers are usually immersed in mineral oil, which is freer from these disadvantages.

Quite recently a synthetic oil patented under the name of 'Pyranol' has been found excellent for insulating purposes and is extensively used in America. The crude oils from which insulating oils are derived can be divided into three types: first, those having a composition of more than 66 per cent of paraffins, that is, saturated open-chain fatty hydrocarbons, such as Pennsylvanian oils; secondly, those consisting of more than 66 per cent of naphthenes, such as Russian oils; and thirdly, those having not more than two-thirds of either paraffins or naphthenes in their composition, such as Rumanian and Texas oils.

The insulating oils obtained from these crude oils are separated by fractional distillation and then purified with sulphuric acid; the tarry deposit resulting from this treatment is removed. The oil is then washed with caustic potash and water to remove any trace of acid. In order to remove the last impurities, such as fibres and dust, from the oil it is finally centrifuged and filtered before dispatch.

The cooling of a transformer depends principally upon the viscosity of the oil used, on which depends the convection currents; the transference of heat being more rapid with low viscosity. Unfortunately, as the viscosity decreases, flashpoint decreases and volatility increases. Thus a compromise has to be made since loss by evaporation is objectionable and fire risk should be as small as possible. Besides these properties, the oil must remain fluid at the lowest temperatures likely to be met with when the transformer is off load. The temperatures at which oils cease to be fluid vary considerably, some congealing at about the freezing point of water, others requiring a temperature lower than −40° C. Two further important attributes of a transformer oil are maximum resistance to the formation of sludge and acid when in service. In Great Britain the principal requirements have been defined and standardized by the British Standards Institution in specification No. 148/1933 entitled "Insulating Oils for Electrical Purposes other than Cables". It also describes the methods of test and the apparatus required.

The oil deteriorates under working conditions, and it is the manner and results of this deterioration that are of moment to the engineer using the transformers. From this point of view the most important characteristic is the variation of the electric strength. The presence of water and particles of solid matter in the oils have the effect of lowering the breakdown value. For example, a mixture of 4 c.c. of water with 3·74 mgm. of fibre in 10,000 c.c. of oil is sufficient to lower the electric strength of a clear dry oil from 100 kilovolts to 37 kilovolts, although both water and fibre are in a pure state. It should be noted that oil absorbs moisture from the atmosphere and therefore, if possible, the filling of transformers or other apparatus with oil should not be done on wet days.

Pyranol is widely used in the United States, especially for indoor and traction work, because of its non-explosive and non-inflammable characteristics. Owing to the removal of the restrictions as to the use of fire-proof vaults, etc., the cost of the Pyranol-filled transformer is generally cheaper than the oil-filled installation. Owing to the high cost of pyranol, it is not thought that it will be widely used in Great Britain, at least for the present. Mr. Calvert thinks that there are cases where its use may be justified. In boiler houses air-cooled transformers have been installed owing to fire risks. In many cases pyranol transformers would be a better substitute, and on economic grounds alone would probably be justified.

ELECTRIC STRENGTH OF SOME SOLID DIELECTRICS

IN connexion with the theory of the breakdown of solid dielectrics, the British Electrical and Allied Industries Research Association has made a helpful technical report* discussing important theories which have recently been advanced, and describing methods by which the 'intrinsic' electric strength of solid dielectrics may be defined and evaluated. It is shown that the magnitudes of, and the effect of temperature and thickness upon, the electric strength of certain crystals agrees with Fröhlich's theory of electronic breakdown. The effect of disordered structure and microstructure also agrees with it in similar instances. On the other hand, departures from theory occur with complex organic dielectrics, and also with crystals when certain limits, for example, of the temperature of the material, are exceeded. Some observations are also made on the effect of temperature and electric stress upon the conductivity of the material.

The object of the present report is to amplify a previous note by A. E. W. Austen and W. Hackett (NATURE, April 15, 1939; p. 637). Experimental values of the electric strength of certain solid dielectrics are compared with the values predicted theoretically from the known structure of the materials. The electrical breakdown is often influenced by the thermal and special electrical conditions under which the test is made; for example, the breakdown due to discharges in a surrounding medium or due to thermal instability. For the present purpose, the electric strength measured must be independent of such conditions. It appears that a type of breakdown which is a property only of the physical nature of the dielectric and its temperature exists, and may be defined. It has been called intrinsic breakdown, and the corresponding field strength is termed the intrinsic electric strength.

---

* Tech. Report, Ref. L/T 114: The Electric Strength of Solid Dielectrics in relation to the Theory of Electronic Breakdown. Pp. 18+9 plates. (London: British Electrical and Allied Industries Research Association.) 3s.

Intrinsic breakdown should possess the following properties: (*a*) it should be independent of thickness over a fairly wide range; (*b*) it should be independent of the nature or duration of the electric stress, provided no appreciable change of temperature occurs as a result of the application of the electric stress, and provided the duration is sufficiently long; (*c*) the actual discharge should occur wholly within the dielectric and in the region where the field is most intense. In the experiments it was found convenient to satisfy certain further conditions.

Attempts have been made to identify intrinsic breakdown with various mechanisms. Fröhlich has examined mathematically the equilibrium of an electron in a solid. His theory shows that beyond a certain critical field-strength an electron may gain energy from the field, and will eventually ionize the lattice. The following deductions can be made from Fröhlich's theory: (*a*) breakdown should increase with temperature for materials having a low Debye temperature, and be practically independent of temperature for substances with a high Debye temperature; (*b*) the electric strength should be independent of thickness until the thickness approaches the order of the electronic mean free path, when the electric strength should increase with decrease of thickness.

Many interesting experimental results on mica and on glass, both plain and coloured, are given. The report concludes that it has been shown that the electric strength of certain solid dielectrics may be defined in such a way that it is independent of the immersion medium, if any, of the shape of the specimen, of the nature of the electrodes, of the nature of the electric stress provided the maximum value persists for a period of a few micro-seconds, and of the thickness, within certain limits. Excellent diagrams are given showing comparisons between experimental and calculated values, the agreement of the variation of conductance with temperature, and the electric strength of clear ruby muscovite-mica.

Based on this report, a paper by A. E. W. Austen and S. Whitehead on the same subject has been communicated to the Royal Society, and is published in the *Proceedings* (A) of August 28, 1940. It describes some recent measurements of the intrinsic electric strength of certain solid dielectrics. This property of homogeneous solid dielectrics is defined, and methods of measurement suitable for a wide range of materials and conditions are described. A comparison of experimental results with Fröhlich's theory yields the following conclusions: (*a*) the electric strengths of mica, quartz, potassium bromide, and other alkali halides agree with the theory; (*b*) the effect of temperature on the electric strengths of mica and potassium bromide agree qualitatively with the theory, while for mica the agreement is also satisfactory quantitatively; (*c*) the electric strength of mica increases when the thickness is reduced to the order of a few mean free paths, and the agreement is quantitative to the accuracy with which calculation is possible; (*d*) fused quartz has a relatively higher electric strength than crystalline quartz, corresponding to the prediction of the theory that disorder increases the electric strength.

YELLOW FEVER AND ITS CONTROL*

In research on yellow fever to-day, the tiny chick embryo, both as minced tissue culture and as the whole embryo in the shell, is one of the most important of the experimental animals used; but man himself was the only useful experimental animal in the study of this disease until as recently as 1927. Research was thus impeded until that time by the reluctance to expose human volunteers to so dangerous an experimental infection.

The extensive history of attempts to learn how the disease was transmitted reveals, nevertheless, that numerous medical men, without thought to their own comfort or safety, performed the most unpleasant experiments upon themselves. A medical student of the University of Pennsylvania during 1802–1803 placed black vomit and blood serum from yellow fever patients in wounds made in his arms and legs and injected black vomit into animals. Other early experimenters exposed their skins to the soiled clothing, bedding, sweat, black vomit, tissues or blood of yellow fever patients.

In none of these experiments did the yellow fever 'take', and the evidence therefore seemed strong that the disease was not contagious. However, there was so much interest in the disease that a total of 556 articles on it are referred to by a writer of 1827, reviewing the literature since 1797.

Although generally accepted proof that a mosquito was the carrier of the disease was not established until the work of Dr. Walter Reed and his associates of the U.S. Army Yellow Fever Commission in 1900 and 1901, Dr. Carlos J. Finlay, of Havana, declared as early as 1881 that he was convinced a mosquito was responsible; and he pointed to the right species, namely, *Aedes ægypti*. Finlay used 102 human volunteers, who permitted themselves to be bitten by mosquitoes which had sucked the blood of yellow fever patients. That the few illnesses observed among his volunteers could not be accepted as yellow fever is due, Dr. Sawyer suggests, to the fact that Finlay did not let the virus incubate long enough in the mosquitoes before they bit the volunteers.

After Reed's brilliant work showed the way to successful control of yellow fever by eliminating the mosquito, no important new discoveries about the disease were made for another quarter century. This was partly because of the deaths of several human volunteers and the reluctance to use more.

Interest in the possibility of immunization was aroused when, in 1927, Drs. A. Stokes, J. H. Bauer and N. P. Hudson, while making investigations in West Africa, discovered that Asiatic monkeys, including the common rhesus monkey, were susceptible to yellow fever. Monkeys were immediately used in the research laboratories to study the disease, but during the first few years of this work many scientific workers became infected and several died. Since the development by Drs. Sawyer, W. Lloyd and W. A. Kitchen in 1931 of a vaccine with which all members of the Rockefeller Foundation yellow fever staff are inoculated, there have been no accidental infections among this group. The vaccine consisted of virus cultivated in mice and when injected was accompanied by a protective quantity of blood serum from people who were immune to the disease.

---

* From a paper by Dr. Wilbur A. Sawyer read on September 17 at the Bicentennial Conference of the University of Pennsylvania.

A curious characteristic of the yellow fever virus which has proved of value in developing vaccines is its manifestation of two types of virulence, namely, 'viscerotropism', meaning that it attacks such viscera as the liver, kidneys and heart, and 'neurotropism', meaning that it damages the nervous system. As the virus occurs in Nature it is capable of inflicting both kinds of damage and is therefore said to be 'pantropic'. But man ordinarily suffers only the viscerotropic attack—in his liver, kidneys and heart. The mouse, on the other hand, is susceptible only to the attack on the nerves, and after long passage through a series of mice the yellow fever virus becomes almost purely neurotropic, that is, capable of attacking only nerve tissue and having little power to damage viscera. It was such a modified virus strain that was thought safest to use on man as a vaccine, since man was thought to be relatively resistant to the neurotropic attack. Nevertheless, immune serum was given with the vaccine to prevent the possible occurrence of a yellow fever encephalitis (brain inflammation).

The next step was so to modify the virus strains that they lost their affinity for the nervous tissue also, and this was attempted by growing the virus in culture media consisting of chick embryos from which the brain and spinal cord had been removed, so that the virus had no nerve tissue on which to grow. The strain thus produced actually has a low virulence for nerve tissue as well as for viscera, and it seems to have undergone a permanent 'evolution' in this direction, for it can now be grown on chick embryos containing the nerve and spinal cord without increasing its virulence for nerves. It is not known, however, whether the fortunate radical change in the virus was due to the absence of brain and cord tissues from the tissue cultures or to an unknown factor. At any rate, this vaccine, produced by workers in the Rockefeller Foundation, and known as 17 *D*, has been used to vaccinate more than a million people in Brazil with results pronounced 'on the whole very satisfactory'.

Another new angle of the yellow fever control campaign is the discovery that not all yellow fever is carried, as had been thought for many years, by the *Aedes œgypti* mosquito, which usually frequents the environs of towns and cities. Yellow fever has also been found in the wild areas of central Africa and South America. It is known as jungle yellow fever, and is probably carried by several species of mosquitoes and possibly harboured also by monkeys and other animals. If jungle fever reaches cities infested with the *Aedes œgypti* it can get into these mosquitoes and start an epidemic of the familiar urban yellow fever. Therefore mosquito control is still an effective weapon. In Brazil, this control includes putting fish in the cistern and water jars to consume the mosquito larvæ.

FORTHCOMING EVENTS

Tuesday, November 5

Institution of Civil Engineers (at Great George Street, S.W.1), at 1.30 p.m.—Sir Leopold H. Savile: Presidential Address.

Wednesday, November 6

North-East Coast Institution of Engineers and Shipbuilders (Student Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 6.45 p.m.—Mr. A. Lawson: "Marine Steering Gears".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Master for Physics and Biology at the Queen's Royal College, Trinidad—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

Assistant Master for Chemistry and Physics at the Queen's College, British Guiana—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

Assistant Mistress for Mathematics in Malaya—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

Lecturer in Geography, and a Lecturer in Physics—The Registrar, Portsmouth Municipal College, Portsmouth.

Permanent Technical Assistant and a Technical Assistant in the Department of Economics—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Lecturer in Engineering Subjects in the Department of Mechanical and Civil Engineering and Building, College of Technology and Art, Rotherham—The Director of Education, Education Offices, Rotherham.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 21: The Swimming and Burrowing Habits of the Amphipod *Urothoē marina* (Bate). By Dr. E. Emrys Watkin. Pp. 271–280. 1*s*. Vol. 60, Part 3, No. 22: Random Paths in Two and Three Dimensions. By Prof. W. H. McCrea and Dr. F. J. W. Whipple. Pp. 281–298. 1*s*. 6*d*. Vol. 60, Part 3, No. 23: An Analysis of the Influence of Weather upon a Migratory Movement of Birds. By Prof. James Ritchie. Pp. 299–321. 2*s*. Vol. 60, Part 3, No. 24: Early Glacial Remains of Reindeer from the Glasgow District. By Dr. M. Macgregor and Prof. James Ritchie. Pp. 322–332. 1*s*. 3*d*. Vol. 60, Part 3, No. 25: The Effect of Increased Daily Illumination and of Reversed Day and Night on the Œstrous Cycle of the Mouse (*Mus musculus*). By Dr. R. A. R. Gresson. Pp. 333–343. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1410

Other Countries

U.S. Treasury Department: Coast Guard. Bulletin No. 28: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1938. By Floyd M. Soule and G. Van A. Graves. Pp. v+173. (Washington, D.C.: Government Printing Office.) [1410

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1939. Pp. 81. (Calcutta: Government of India Press.) [1410

Records of the Indian Museum. Vol. 42, Part 2: On the Systematic Position, Structural Modifications, Bionomics and Development of a Remarkable New Family of Cyprinodont Fishes from the Province of Bombay. By C. V. Kulkarni. Pp. 379–423. (Calcutta: Indian Museum.) [1410

Preliminary Annual Report of the Public Health Commissioner with the Government of India for 1939. Pp. iii+75. (Delhi: Manager of Publications.) 8 annas; 9*d*. [1410

Catalogues, etc.

The Wild-Barfield Heat-Treatment Journal. Vol. 4, No. 26. Pp. 10–22+iii. (Watford: Wild-Barfield Electric Furnaces, Ltd.)

Multipoint Temperature Indicator. (E. 15.) Pp. 4. Pyrometer Controller. (E. 17.) Pp. 6. Recording Pyrometer. (E. 19.) Pp. 6. (London: Negretti and Zambra.)

A Catalogue of Books and Periodicals on General Natural History, including a Selection on Hawking, Hunting, Shooting. (No. 580.) Pp. 40. (London: Bernard Quaritch, Ltd.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 9, 1940 No. 3706

CAMOUFLAGE IN MODERN WARFARE

THE science and art of camouflage is playing, and will continue to play, a great part in the present struggle. Much progress has been made during the past twenty-five years in the establishment of certain well-defined principles of camouflage, based on research in biology and psychology. But as pointed out in NATURE of June 22, p. 949, the authorities in the various Service Departments concerned have been slow to make the most of this scientific progress; in fact, the history of war camouflage up to that time had provided a very convincing example of the ineptitude of the system then existing, so far as science was concerned.

After examining the personnel engaged at the Civil Defence Camouflage Establishment, one could scarcely feel reassured concerning the future prospects. Of the sixty-five technical officers, all but four were either professional artists or art students. There was no biologist. It was scarcely to be wondered at, therefore, that, since there was little recruitment of authorities on biological and psychological principles, failure to achieve effectiveness was the rule rather than the exception.

This deplorable situation was also emphasized in "Science in War" (Penguin Special, S74. 6*d.*; see also NATURE of July 27, 1940, p. 112). But after this, the scientific spirit began to show signs, though somewhat tardily, of coming into its own; and we were glad to print evidence of this from "J. S. H." after a visit to the Civil Defence Camouflage Organization (see NATURE of October 12, p. 482). There, the experimental work is under the direct supervision of Prof. W. E. Curtis, who is assisted by a technical staff of artists, engineers, architects, chemists, physicists, photographers and a botanist.

It is useless crying over spilt milk, yet one cannot resist deploring this important enemy of efficiency—delay. Now that the research branch of this all-important problem has been accorded better foundations, the two immediate aims for the future must be still further improvements in scientific personnel and research, and the quick recognition of their value and application of their findings by all Service authorities to whom such findings may prove of even the smallest value.

So far as the first aim is concerned, it might be of advantage to the Civil Defence Station if it ensures that it is exploring all psychological principles that have an important role in camouflage, for, as Dr. H. J. Eysenck points out on p. 620 of this issue, no specialist in psychology is apparently employed at the Station. It is possible that some, if not all, of those scientific workers already employed at the Station are fully aware of such principles and have a sufficient working knowledge of psychology to apply them; all the same, if a good specialist interested in the psychology of perception is available we suggest that he should either be placed on the research staff or invited to serve as a consultant. However, so far as the Station is concerned, it is gratifying to note, as "J. S. H." pointed out, "The art of camouflage has in the last six months gone far in utilizing scientific knowledge and scientific methods".

The second and equally important aim, namely, utilization and application of scientific method by the Services, and also co-ordination among themselves, has not hitherto been so reassuring. But the fourteenth report from the Select Committee on National Expenditure (H.M. Stationery Office. 2*d.*) which deals with this subject goes far to convince us that the Services now realize the seriousness of the situation and that many major changes are already overdue.

It is now recognized that camouflage is both an art and a science. The discovery of means and elaboration of technique are scientific; the execution of schemes are matters requiring visual training and artistic knowledge. Men of both kinds of knowledge are therefore now being employed in research. The report, however, emphasizes chiefly that the organization of the scientific side of the matter appears to require the more urgent attention. This is due to the fact, no doubt, that until comparatively recently men of science have neither been employed nor consulted.

Several Departments are now concerned, to various degrees of urgency, with camouflage. The Ministry of Home Security is concerned with the camouflage of factories, mines, public utility undertakings, etc. This Ministry now refers to the Civil Defence Camouflage Establishment.

The Directorate of Works in the Department of the Member of the Air Council charged with supply and organization is responsible for the camouflage of aerodromes and Air Ministry buildings, and the work is administered from the Air Ministry. This branch is directed by a chief engineer with a designing staff of nine, and its work approved by the inspector of camouflage assisted by a personal assistant and two technical officers. One camouflage officer is stationed at each of fifteen Works Area Headquarters. The Royal Aircraft Establishment at South Farnborough is responsible for research. Schemes are adopted for aircraft after various tests by the Royal Air Force in consultation with the Royal Aircraft Establishment. The actual work of camouflaging aircraft and road vehicles is the responsibility of the Ministry of Aircraft Production.

The Directorate of Engineers and Signals Equipment (of the Ministry of Supply) is responsible for the camouflaging of Royal Ordnance factories, Ordnance depots and War Department buildings, guns, machine-gun posts and vehicles. Those directly responsible are two officers under the direction of the Assistant Director, who has other duties unconnected with camouflage. The Directorate refers its research to the Civil Defence Camouflage Establishment.

So far as the Admiralty is concerned, one camouflage officer is in charge of the camouflage of naval establishments. The Air Ministry is responsible for Fleet Air Arm bases. Research is referred to the Civil Defence Establishment.

The camouflage of ships has been abandoned. No doubt there are good reasons for this. The rapid development of aircraft reconnaissance at sea and the increased utilization of heavy smoke screens may have been largely responsible for rendering ship's camouflage unnecessary and, indeed, useless; yet it is to be hoped that the Admiralty authorities realize that "half the battle in science consists in asking new questions which the non-scientist cannot be expected to think of", and thus keep an open mind on, and still remain receptive concerning, this problem.

Advice on camouflage required by the Army in the field is provided by a special staff of camouflage officers attached to Corps and Divisions. The officers have been drawn from the Army and civil occupations and include two assistants from the Civil Defence Camouflage Establishment.

Even the layman has often been heard to remark that many existing examples of Service and civil camouflage are useless almost to the degree of absurdity. This is obviously fully realized now by the Services and reiterated by the Sub-Committee's report. The broadening of research now taking place will ensure that at any rate there shall be no excuse for the continued utilization of such absurd methods. But any intelligent layman, after reading the report, would also recognize the lack of organization and collaboration extant throughout the Services. The above details of the various Services' work in this connexion should dispel any doubts. The position is far from satisfactory, and the Sub-Committee admits it.

Now that the report openly states that the execution of camouflage and research into its problems are closely bound up with each other, we are entitled to expect that complete co-ordination between research staffs and the Services will soon take effect. Each camouflage department will no longer maintain its own research staff; it is now recommended that the four departments which are responsible for the design and execution of schemes of camouflage should be concentrated in a single camouflage department with its own research staff. This is obviously all to the good, but it has the added advantage that the knowledge resulting from research would be more readily available to the executive staff. At last, the responsible authorities realize the indubitable advantages of co-ordination of research and organization, as already exemplified in scientific research by such developments as team work in universities and research associations in industry.

WELL-BEING OF MUNITION WORKERS

The Health and Efficiency of Munition Workers
By Dr. H. M. Vernon. (Oxford Medical Publications.) Pp. vii+128. (London: Oxford University Press, 1940.) 8*s.* 6*d.* net.

THE Oxford School of Physiology, founded by Burdon Sanderson, and adorned by his successors, Gotch, Sherrington, and John Mellanby, has produced many eminent men of science whose researches have benefited mankind. To industrial hygiene the contributions of the late J. S. Haldane have been important, while for many years Dr. H. M. Vernon has brought physiological knowledge and experience to bear upon the health problems of the industrial worker.

During the War of 1914–18, as investigator for the Health of Munition Workers Committee, Dr. Vernon shared in the high standard of work achieved by Prof. Major Greenwood, E. L. Collis, and others, which ameliorated the lot of the munition worker. Afterwards, he continued and extended his investigations for the Committee's successor, the Industrial Health Research Board. His studies have covered many subjects in this field, such as industrial fatigue and efficiency, the output of munition workers in relation to hours of work, alcohol and industrial efficiency, ventilation and heating in factories, etc., all studies which are not only of scientific interest, but also are of vital importance to employers and those employed in industry.

Last year, Dr. Vernon garnered the fruits of these years of patient investigation in a volume entitled "Health in Relation to Occupation" (see NATURE, July 6, p. 6). This work showed that, as a rule, ill-health is due only in a moderate degree to the direct effects of occupation. "Social environment, including nutrition," he writes, "has much more powerful effect, whilst hereditary influences, especially intelligence, are also very powerful." Dr. Vernon admitted that it was still a difficult problem to ascertain the relative degrees of importance to be attached to the three factors mentioned, but he rightly claimed that his book summarized existing knowledge and pointed out the directions in which further information is required. To-day, we are once more in the thick of a great war, and are again dependent—and with the advance made in destructive instruments of warfare even more dependent than twenty-five years ago—upon munition workers for our national security.

It is fortunate and timely, therefore, that Dr. Vernon has followed up his more general book of last year with a monograph devoted to "The Health and Efficiency of Munition Workers". His extensive knowledge of the subject makes this book an important contribution to national effort. Every day for the last six months come demands for more aeroplanes, more guns, more tanks, more ammunition, more destructive weapons of all kinds. Factories spring up like mushrooms all over the country, and workers flock into them whose enthusiasm must be guided and controlled by skilled training and direction, and, above all, by the rules of health. Otherwise, there will be waste of effort, diminished efficiency and output, and wastage of man-power due to accidents and ill-health.

The conditions under which munition industries are conducted should be so arranged that the workers can retain their fitness and vigour. As Dr. Vernon observes, the workers' sense of patriotism undoubtedly stimulates them to work harder than in peace-time. This incentive must, however, be applied with discretion, both by the employers and the employed, for otherwise it will defeat its chief object. Grievous errors made in this respect in the earlier stages of the War of 1914–18 had to be remedied and overtaken by the recommendations of the Health of Munition Workers Committee, and although much time has been devoted in the intervening years to studying the best ways of promoting industrial health and efficiency, as recent experience has shown, it cannot be assumed that the past errors will be altogether avoided without due care and foresight. Many employers and managers of industrial establishments have no special knowledge about industrial health and its maintenance, and they need to be reminded of the precautions which ought to be taken.

The present little book covers succinctly the essentials of the problem. It treats of hours of work, work spells and rest pauses, and shift systems, including day and night shifts. Dr. Vernon wisely drives home the lesson, which employers of labour have been slow to learn, that to over-drive the human machine damages the health of the individual worker, and is bad business for the employer, because the worker's output and efficiency deteriorate with long hours of labour. Yet so far back as 1816 Robert Owen discovered that when he ran his New Lanark mills for 10½ hours a day instead of the usual 15–16 hours a day, output did not fall sensibly below its previous level.

The more medical chapters of the book discuss sickness and absenteeism, and accidents and injuries. This brings up the question of rehabilitation of the industrial worker, to which considerable thought is being given at the present time.

There is a useful chapter on the ventilation, heating, and lighting of factories, and the influence of noise on efficiency. The book concludes with a concise account of welfare and labour management.

We have two points of criticism. One is that the author might have emphasized more strongly the importance of linking up the medical and care work of the factory with the national health services, for the munition worker has a social environment as well as an occupational one. Although Dr. Vernon devoted considerable space to this matter in his previous book, a reminder here would have been advantageous. The other point is that this book with such a wide appeal might have been published at a lower price, even in these difficult times. It should be read by every employer of munition workers, and a copy should be placed in every works library.

A. S. MacNalty.

MARXISM IN HISTORY EXPOSED

The Materialist Conception of History
A Critical Analysis. By Karl Federn. Pp. xiv+263. (London: Macmillan and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THIS is the most admirable exposé of the fallacies of the materialist conception of history that I have ever come across. The author, who is a Viennese in exile, has taken the trouble to go through the fifteen propositions in the introduction to Marx's "Criticism of Political Philosophy" written in London in 1859 and other Marxist writings, and tried to sift out any grains of truth there may be in them. Dr. Federn is a historian apparently familiar with both ancient and modern times, and he writes with impartiality and in a clear and very attractive style. The style indeed is so good that one wonders that any foreigner should have been capable of writing it. But, as no name of a translator is given, one supposes that the author is as perfect a linguist as he is undoubtedly a wide and accomplished historian.

It is much to be hoped that the book will be largely circulated, for the fallacies which it exposes are much in vogue with the non-historical younger part of our people at the present moment, and the serious historian rarely turns out of his path to expose them. That is why we should be particularly thankful to Dr. Federn for having done it, and done it so conclusively that no one who takes the trouble to read the book and can understand the meaning of a simple sentence, would ever again be confused by the sophistries of material dialecticism.

One can only give in a few sentences the general gist of the book. Marx maintains in one of the fifteen propositions referred to above that the "conditions of production", namely, the economic structure of society, determine all the superstructure, that is, the laws, the science, the religion, the art of every age. Dr. Federn's answer comes briefly to two propositions. One, that in every age the conditions of production, that is, how mankind at that time make their living, will undoubtedly have some effect on the way they think and act in other matters, but that this influence is only one of a mass of influences on our thought which are too numerous and subtle to be summarized in any such statement. Indeed to find the relations of the economic and other conditions in any one historical period is often more than the work of a lifetime. Second, that the Marxist view derives almost entirely from a consideration of the last hundred or two years. The farther back we go the less clear is the connexion and the more inadequate is Marx's knowledge of what has been discovered. Thus prehistory does not exist for him, and he sweeps all the hundreds of thousands of years of human history before the civilization which he calls "Antique" into the one incomplete and misleading formula, that the conditions of production, that is, the economic side of history, determine everything.

Dr. Federn really disposes of the whole sophistical structure in one of his earlier sentences: "Discovering a new productive force as well as finding out a method of applying it are mental acts. If this were not the case, if there were no need of intelligence to discover and employ the forces of nature, the animals would discover and employ them also and the inferior races would develop a civilization as quickly as the higher".

The moral is, what generations of better historians than Marx have long known and explored, that mind and not matter rules the world. The use and charm of Dr. Federn's book is that a deeply read historian has traced the fallacy through all the main stages of human civilization without writing a dull or unnecessary word.

It is much to be wished that the book in some form should become available for all students and teachers of history.

F. S. Marvin.

FARMING AS A BUSINESS

Farm Management
In-going and Out-going, Insurance, Income Tax, Credit and Farm Records. By K. W. D. Campbell. Pp. 156. (London: English Universities Press, Ltd., 1940.) 8*s*. 6*d*. net.

THIS book is frankly a disappointment, for a good text-book dealing with the principles of farm management has long been needed.

Farming has been called a science, an art, a business and a way of life. In fact, as Prof. Scott Watson says in his foreword, it is all of these. But it is only within the last twenty years that the importance of teaching the business side of the subject has begun to be realized. There was a time when it was thought sufficient to teach the agricultural student science and science only, ignoring the art. But it soon became evident that a purely scientific training was wholly inadequate, and in spite of much of what had once been exclusively an art having been converted to a science, yet a great deal of the art still remained and showed no sign of ever being reduced to scientific form. Science can be taught in lecture room and laboratory, but the practical art of husbandry can be taught only on the farm itself. Hence the necessity for university and college farms. But the matter did not end here, for it appeared that even a combination of science and art were not enough. No amount of scientific knowledge will compensate for a lack of business ability, and no amount of technical skill will ensure the success of a farm judged as a business. Hence the growing recognition of the need for including teaching in the business aspects of the subject in the agricultural student's curriculum.

One of the difficulties of developing this side of agricultural education has been the want of suitable text-books. It is therefore most unfortunate that the first book of the kind should be published at such a time as this, for the book under notice was planned, as the author explains, only as the first part of a comprehensive work on the subject of farm management, a task the completion of which the advent of the War made impossible. But it is incomprehensible why for the first volume the author should have singled out the particular aspects of farm management that he has. In-going and out-going, insurance, income tax, credit, etc.; the list is not inspiring, and includes subjects a knowledge of which is certainly desirable, but few of which can be said to have much educational value.

The book imparts a mass of information on a number of incredibly dull subjects, information which no doubt is correct to-day but all of which may be changed to-morrow. It deals with facts rather than with principles; it is informative rather than educational. It is a book that may be of value to the farmer and even to the agricultural student for reference purposes, but it is certainly one that will never be read from interest.

Parts of the book, however, indicate that the author is capable of other and better things, and that if only he would deal with the fundamental principles of farm management rather than with detail, a book of permanent value might result. The chapter on choosing a farm is an example, though even this chapter is open to criticism, for the author draws no clear distinction between inherent fertility and condition. This is the more important in that the two are always liable to be confused in the student's mind.

Let us hope that when the second part of the book comes to be written the author will deal with the subject in a different way, a way in which he has already shown himself to be capable.

WILFRID MANSFIELD.

THE HISTORY OF JERICHO

The Story of Jericho
By John Garstang and J. B. E. Garstang. Pp. xv+200. (London: Hodder and Stoughton, Ltd., 1940.) 8*s*. 6*d*. net.

IN Old Testament history the fall of Jericho is the culmination of a long drawn-out drama which has impressed itself upon the imagination of most generations of men—and not Israelites alone. In archæology the excavations on the site of the city which have been carried out by Prof. John Garstang over a period of years have set the development of early civilization in Palestine in a new and arresting perspective. Not only do we now see the beginning of those relations with the two great empires lying on either side which were to have a decisive effect on the growth and influence of Palestine in history, but we also are carried back unexpectedly to the earliest known settlement of man in Palestine, or it may be indeed as Prof. Garstang remarks, one of the oldest "in the whole world". In the north-east corner of the walled enclosure the remains of late stone age buildings deep below the foundations of the walled city proved to be the latest of a series of neolithic deposits which led down, stage by stage, to a further depth of 23 ft., evidence of a long and peaceful occupation and development. Beneath these, at a depth of 6 ft. below the Bronze Age walls of 3000 B.C., were evidences of the earliest settlers in the form of primitive and, generally, pygmy flint implements, seemingly characteristic of the mesolithic period, and as such comparable with the culture of the inhabitants of the caves of Mount Carmel discovered in her excavations by Prof. Dorothy Garrod. To this early settlement a tentative dating of some period before 5000 B.C. is assigned. The earliest or lower neolithic falls at 4500 B.C., contemporary with the Proto-Chalcolithic period of Mersin in Cilicia, recently also excavated by Prof. Garstang himself. He points out that while these early neolithic settlements are to be regarded as of local origin and growth, in Palestine as at Mersin there is an early development of architectural features. Especially noteworthy at Jericho is the appearance of a megaron-like temple and the practice of burnishing the plastered walls and floors. It is also worthy of special remark that pottery first appears in the Middle Neolithic period, and in forms which Prof. Garstang interprets as pointing to independent invention. This period, which is purely stone age, is contemporary with the early Chalcolithic of northern Mesopotamia. It has distant cultural affinities with Tepe Zawra, Ras Shamra and the Fayoum, but shows a characteristic time lag.

In the six seasons of excavation which were devoted to the examination of the site, evidence of four successive cities was brought to light. Of these the earliest dates from the Early Bronze Age of 3000 B.C., pre-dynastic Egyptian object appearing beneath its foundations, but with Babylonian art and religious influence dominant within its period. In the Middle Bronze Age (2000 B.C.) the Canaanites appear, but later (1750 B.C.) it becomes a Hyksos fortress until 1600 B.C. when the city was totally destroyed at the time the Egyptians drove out the Hyksos and established the New Empire. Thenceforth until the fall of the city, which Prof. Garstang argues must have taken place in the reign of Amenhotep III, c. 1390 B.C., Palestine was under Egyptian domination, although there is evidence to show that at the period of the Hebrew invasion it was passing through a phase of decadence.

Prof. Garstang in this review of the material upon which he has reported in detail from time to time elsewhere, has in view the interests of the reader to whom the appeal of the archæological data is subservient to the solution of the problem presented by the Biblical narrative—"Why and how did Jericho fall ?" When all the evidence to be gathered from examination of the site has been presented in outline, Mr. J. B. E. Garstang takes up the story and shows how all the different classes of evidence which can be brought to bear converge to show that the Exodus, including the Plagues, the drying up of the Red Sea, and the incidents of the sojourn in the wilderness, as well as the fall of the walls of the city, is to be attributed to a period of intense volcanic activity culminating in a violent earthquake, to which the records show that the rift in which Jericho is situated has always been subject. The latest serious recurrence which reproduced features mentioned in the biblical narrative took place so recently as 1927.

PROBLEMS OF THE VIRUS

The Virus
Life's Enemy. By Kenneth M. Smith. (Cambridge Library of Modern Science.) Pp. viii + 176 + 9 plates. (Cambridge : At the University Press, 1940.) 7*s*. 6*d*. net.

THE present time is ripe for a general review of the problems of virus diseases elucidated during the last decade, and Dr. Kenneth Smith has recognized the opportunity by writing this volume. He is an accepted authority on plant viruses, but this latest work does not confine its allegiance to the plant kingdom. It is a conspectus of virus phenomena, and draws authoritative illustrations with equal facility from animal and plant diseases. One good effect of this is to show the essential similarity of virus upon both types of host ; a worker in plant viruses investigates the same principles which present themselves from the animal side. The first part of the volume discusses the nature of virus ; how it was discovered, how it is studied, and what is its nature. Part 2, "The Virus in Action", discusses methods of infection and the action of virus upon the living cell. It is this section, and that which outlines a range of the more important virus diseases, which justify the volume's sub-title "Life's Enemy". A chapter on control of these maladies is also added, and Dr. Smith's specialist studies of the entomological implications of virus diseases make fascinating reading, for the relations of a virus with its insect vector have a tantalizing complexity.

The range of diseases outlined in the volume is necessarily not extensive; it is the author's design to parade the various types of host before the reader, and accordingly typical diseases of man and domestic mammals, of birds, fish, plants and bacteria are described. A very interesting discussion is given of the relations of viruses with malignant tumours, and it is good to see that scientific investigation is again directed to this possibility. The peculiar action of virus upon living cells is considered. The parasite can stimulate or destroy the cell, and it may vary in its effects, even to the production of a new type of disease. Nineteen excellent plates portray symptom-complexes which are relatively common.

Dr. Smith considers that the virus is probably rather more inanimate than living, because of the recent work upon the crystalline nature of virus protein. He is, however, perhaps a little too definite when he says, in answer to the question "Are viruses living or non-living?" that "This starts a hare which can never be caught" (p. 37). The question is indeed difficult; but is not impossible of solution. Evaluation of all incompletely determined phases of the problem is quite fair, however, and the author takes pains to give both sides of the question, where two exist.

Clarity and simplicity of expression render this treasury of information available to the general reader. This is a book which could only have been written by a master of the subject; it is rich in the intangible value of background; it can be read with pleasure in its expression, for it is a contribution to general culture, but it has also the full merit of an exact scientific review.

J. Grainger.

CHEMICAL CHANGE

The Kinetics of Chemical Change
By Dr. C. N. Hinshelwood. Pp. vii+274. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 15*s*. net.

PROF. HINSHELWOOD'S first book on chemical change appeared in 1926 and later ran into three editions. There is little doubt that a fourth edition would have been welcomed as eagerly as its predecessors were; but the author has adopted the heroic course of writing a new book instead of expanding the old. It would be an under-statement to state that the result is satisfactory—that was to be anticipated; the treatment of the subject in the present volume is by far the most satisfactory and interesting that has yet been written.

In the kinetics of chemical change the energy of activation is the fundamental factor that is involved, and is at present the one quantity which has to be determined by experiment, although in simple cases, as shown by Eyring and by Shermann, it is possible to calculate the value from molecular dimensions and band spectra values.

Apart from this problem of the energy of activation, there are in general three methods of approach to gas reactions: the kinetic, the statistical and that of the transition state. It is important to realize the assumptions which have to be made or are tacitly assumed in each method of treatment so as to obtain formal agreement both with each other and with the experimental data. It is a much more difficult matter to decide whether they all do, in fact, portray the same molecular mechanism of reaction and, if so, that the one they do describe is the correct one. For example, we might regard the mechanism of reaction between two molecules as involving on one hand a steady but decelerated mutual approach during which the valency bonds undergo any necessary continuous change in orientation before the quasi-equilibrium of the transition state is attained, or on the other hand we might regard the mechanism as more akin to the dropping of a glass object on a hard surface—at a critical velocity of impact with the correct orientation the glass breaks. As an alternative simile we might contrast a photochemical change at the threshold of the continuous spectrum with one in which a jump to a new level of excitation is involved.

Some four chapters are devoted to gas reactions, and although these comprise only one hundred pages of text, there is scarcely a point of interest or importance which has been left out. It is admittedly difficult to distinguish experimentally between a unimolecular reaction obeying the Lindemann mechanism and one involving short chains. To accept the usual criterion of change in the velocity constant with the pressure is dangerous when more than one reaction mechanism is involved; thus to account for the decomposition of azo-isopropane on the unimolecular basis it must have at 150° C. a specific heat of some 40–50 calories. This seems a large value, and further work on specific heats of this and similar substances is clearly desirable.

In contrast to the reactions in homogeneous phases, the author devotes only some fifty-five pages to heterogeneous reactions. Whilst the difference between chemi-sorption and physical or van der Waals' adsorption is mentioned, it is debated whether there is a true distinction between the two kinds. Many now would take the view that catalytic reactions function because both kinds of adsorption are involved and that the act of catalysis involves a switch-over of the 'adsorbed' constituents from one type to another.

In the last chapter several general aspects of chemical change are discussed, of especial interest being the section on a comparison of reactions in the gaseous state with those in solution.

The author is to be congratulated on a magnificent achievement. In the preface he states that it is written for anyone who cares to read it; the reviewer might add, anyone who cares to read it will read it again and again. Eric K. Rideal.

HISTORY OF LABORATORY APPARATUS

The Tools of the Chemist

Their Ancestry and American Evolution. By Ernest Child. Pp. 220. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 21*s*. net.

If it be true, as has often been emphasized, that scientific progress is associated with the development of new laboratory methods and technique, then the story of laboratory apparatus becomes a part of the history of chemical education. This is a special branch of historical chemistry so it requires close contact with the instrument business for its investigation; the author, long associated with Eimer and Amend of New York, has proved fully capable of discharging his self-assumed task. Though limited to American chemistry, Mr. Child has necessarily gone back to European origins so as to place his picture in its proper setting. The resulting story, briefly told in an attractively produced book, makes the most pleasant reading: we would recommend its perusal to our colleagues.

Sellers of scientific apparatus are not to be regarded as mercenary and tainted with commercialism. The great Gay-Lussac founded with Collardeau a firm for the manufacture of the burette, vapour density and other apparatus he had originated. Accum, a gentleman of whom there are two opinions to-day, declared "that he who establishes a place of fabrication of an article of use to the sciences is a benefactor to the public".

American chemists, like the British, were too dependent, prior to 1914, upon Continental manufacturers and dealers for much of their scientific equipment. Hundreds of chemists who became future leaders studied in Continental laboratories and on their return home naturally ordered the apparatus with which they were familiar. The implications of this sentence might well be pondered over for the future: Britain must see to it that after the War she attracts students from both the Americas, the Dominions, the East, and even from the Continent, that besides teaching them science they are also inculcated with British ideals and the habit of buying British. This form of propaganda is both necessary and justifiable, and might properly form an activity of the British Council.

America, of course, owes much to its emigrants, skilled mechanics from England, Holland and France, while as a result of the political disturbances of 1848 many glassblowers and instrument makers came from Germany.

The text is divided into three sections, the first headed "People and Events", the second entitled "Ancestry and Development", whilst the third gives the history of the distributors of apparatus in America. The first recorded importation of apparatus and chemicals into North America was made by John Winthrop in 1633; the cradle of American laboratory apparatus was in Philadelphia, where thermometers and hydrometers and "glasses for Philosophical Experiments" were made so far back as 1785.

Mr. Child has a happy knack of mixing past and present, and is clever in selecting his illustrations and quotations.

In days when there is serious discussion in the columns of Nature of curtailing the practical course in school training in science, it is worth while quoting a philosophy expressed in the eighth century by Jābir ibn Hayyān, the great chemist of Islam. "The first essential in chemistry is that thou shouldst perform practical work and conduct experiments." This is as true to-day as when it was written; it applies above all to schools. We fail to-day because we are not a practical nation; nine tenths of us in the towns are unable to use our hands. We are trained to fill in forms and not to work lathes, so that most of us are helpless when emergency arises. The same philosopher also says, "But thou, oh my son, do thou experiment so that thou mayest acquire knowledge". It is in the laboratory that progress is made; the chemist must look to it that his tools are ready.

We thank Mr. Child for a delightful book.

E. F. Armstrong.

SCIENCE AND RELIGION*

By Prof. Albert Einstein, For.Mem.R.S.

IT would not be difficult to come to an agreement as to what we understand by science. Science is the century-old endeavour to bring together by means of systematic thought the perceptible phenomena of this world into as thorough-going an association as possible. To put it boldly, it is the attempt at the posterior reconstruction of existence by the process of conceptualization. But when asking myself what religion is, I cannot think of the answer so easily. Even after finding an answer which may satisfy me at this particular moment, I still remain convinced that I can never in any circumstances bring together, even to a slight extent, all those who have given this question serious consideration.

At first, then, instead of asking what religion is, I should prefer to ask what characterizes the aspirations of a person who gives me the impression of being religious: a person who is religiously enlightened appears to me to be one who has, to the best of his ability, liberated himself from the fetters of his selfish desires and is preoccupied with thoughts, feelings, and aspirations to which he clings because of their super-personal value. It seems to me that what is important is the force of this super-personal content and the depth of the conviction concerning its overpowering meaningfulness, regardless of whether any attempt is made to unite this content with a Divine Being, for otherwise it would not be possible to count Buddha and Spinoza as religious personalities. Accordingly, a religious person is devout in the sense that he has no doubt of the significance and loftiness of those super-personal objects and goals which neither require nor are capable of rational foundation. They exist with the same necessity and matter-of-factness as he himself. In this sense religion is the age-old endeavour of mankind to become clearly and completely conscious of these values and goals, and constantly to strengthen and extend their effects. If one conceives of religion and science according to these definitions, then a conflict between them appears impossible. For science can only ascertain what is, but not what should be, and outside its domain value judgments of all kinds remain necessary. Religion, on the other hand, deals only with evaluations of human thought and action; it cannot justifiably speak of facts and relationships between facts. According to this interpretation, the well-known conflicts between religion and science in the past must all be ascribed to a misapprehension of the situation which has been described.

For example, a conflict arises when a religious community insists on the absolute truthfulness of all statements recorded in the Bible. This means an intervention on the part of religion into the sphere of science; this is where the struggle of the Church against the doctrines of Galileo and Darwin belongs. On the other hand, representatives of science have often made an attempt to arrive at fundamental judgments with respect to values and ends on the basis of scientific method, and in this way have set themselves in opposition to religion. These conflicts have all sprung from fatal errors.

Now, even though the realms of religion and science in themselves are clearly marked off from each other, nevertheless there exist between the two strong reciprocal relationships and dependencies. Though religion may be that which determines the goal, it has, nevertheless, learned from science, in the broadest sense, what means will contribute to the attainment of the goals it has set up. But science can only be created by those who are thoroughly imbued with the aspiration towards truth and understanding. This source of feeling, however, springs from the sphere of religion. To this there also belongs the faith in the possibility that the regulations valid for the world of existence are rational, that is, comprehensible to reason. I cannot conceive of a genuine man of science without that profound faith. The situation may be expressed by an image: science without religion is lame, religion without science is blind.

Though I have asserted above, that in truth a legitimate conflict between religion and science cannot exist, I must nevertheless qualify this assertion once again on an essential point, with reference to the actual content of historical religions. This qualification has to do with the concept of God. During the youthful period of mankind's spiritual evolution, human fantasy created gods in man's own image, who, by the operations of their will, were supposed to determine, or at any rate to influence, the phenomenal world. Man sought to alter the disposition of these gods in his own favour by means of magic and prayer. The idea of God in the religions taught at present is a sublimation of that old conception of the gods. Its anthropomorphic character is shown, for example, by the fact that men appeal to the Divine Being in prayers and plead for the fulfilment of their wishes.

---

* From a written communication to the Conference on Science, Philosophy and Religion recently held at the Jewish Theological Seminary of America, New York.

Nobody, certainly, will deny that the idea of the existence of an omnipotent, just and omnibeneficient personal God is able to accord man solace, help, and guidance ; also, by virtue of its simplicity the concept is accessible to the most undeveloped mind. But, on the other hand, there are decisive weaknesses attached to this idea in itself, which have been painfully felt since the beginning of history. For example, if this Being is omnipotent, then every occurrence, including every human action, every human thought, and every human feeling and aspiration is also His work ; how is it possible to think of holding men responsible for their deeds and thoughts before such an Almighty Being ? In giving out punishment and rewards He would to a certain extent be passing judgment on Himself. How can this be combined with the goodness and righteousness ascribed to Him ?

The main source of the present-day conflicts between the spheres of religion and of science lies in this concept of a personal God. It is the aim of science to establish general rules which determine the reciprocal connexion of objects and events in time and space. For these rules, or laws of Nature, absolutely general validity is required —not proven. It is mainly a programme, and faith in the possibility of its accomplishment in principle is only founded on partial successes. But scarcely anyone could be found who would deny these partial successes and ascribe them to human self-deception. The fact that on the basis of such laws we are able to predict the temporal behaviour of phenomena in certain domains with great precision and certainty, is deeply embedded in the consciousness of the modern man, even though he may have grasped very little of the contents of those laws. He need only consider that planetary courses within the solar system may be calculated in advance with great exactitude on the basis of a limited number of simple laws. In a similar way, though not with the same precision, it is possible to calculate in advance the mode of operation of an electric motor, a transmission system, or of a wireless apparatus, even when dealing with a novel development.

To be sure, when the number of factors coming into play in a phenomenological complex is too large, scientific method in most cases fails us. One need only think of the weather, in which case prediction even for a few days ahead is impossible. Nevertheless, no one doubts that we are confronted with a causal connexion the causal components of which are in the main known to us. Occurrences in this domain are beyond the reach of exact prediction because of the variety of factors in operation, not because of any lack of order in Nature.

We have penetrated far less deeply into the regularities obtaining within the realm of living things, but deeply enough nevertheless to sense at least the rule of fixed necessity. One need only think of the systematic order in heredity, and in the effect of poisons, as, for example, alcohol on the behaviour of organic beings. What is still lacking here is a grasp of connexions of profound generality, but not a knowledge or order in itself.

The more a man is imbued with the ordered regularity of all events, the firmer becomes his conviction that there is no room left by the side of this ordered regularity for causes of a different nature. For him neither the rule of human nor the rule of Divine Will exists as an independent cause of natural events. To be sure, the doctrine of a personal God interfering with natural events could never be *refuted*, in the real sense, by science, for this doctrine can always take refuge in those domains in which scientific knowledge has not yet been able to set foot.

But I am persuaded that such behaviour on the part of the representatives of religion would not only be unworthy but also fatal. For a doctrine which is able to maintain itself not in clear light but only in the dark will of necessity lose its effect on mankind, with incalculable harm to human progress. In their struggle for the ethical good, teachers of religion must have the stature to give up the doctrine of a personal God, that is, give up that source of fear and hope which in the past placed such vast power in the hands of priests. In their labours they will have to avail themselves of those forces which are capable of cultivating the good, the true, and the beautiful in humanity itself. This is, to be sure, a more difficult but an incomparably more worthy task. (This thought is convincingly presented in Lord Samuel's book, "Belief and Action".) After religious teachers accomplish the refining process indicated, they will surely recognize with joy that true religion has been ennobled and made more profound by scientific knowledge.

If it is one of the goals of religion to liberate mankind so far as possible from the bondage of egocentric cravings, desires and fears, scientific reasoning can aid religion in yet another sense. Although it is true that it is the goal of science to discover rules which permit the association and foretelling of facts, this is not its only aim. It also seeks to reduce the connexions discovered to the smallest possible number of mutually independent conceptual elements. It is in this striving after the rational unification of the manifold that it encounters its greatest successes, even though it is precisely this attempt which causes it to run the greatest risk of falling a prey to illusions. But whoever has undergone the intense experience of successful advance made in this domain is moved by profound reverence for the rationality made manifest in existence. By way of the understanding he achieves a far-reaching emancipation from the shackles of personal hopes and desires, and thereby attains that humble attitude of mind towards the grandeur of reason incarnate in existence which, in its profoundest depths, is inaccessible to man. This attitude, however, appears to me to be religious in the highest sense of the word. Thus it seems to me that science not only purifies the religious impulse of the dross of its anthropomorphism, but also contributes to a religious spiritualization of our understanding of life.

The further the spiritual evolution of mankind advances, the more certain it seems to me that the path to genuine religion does not lie through the fear of life, and the fear of death, and blind faith, but through striving after rational knowledge. In this sense, I believe that the priest must become a teacher if he wishes to do justice to his lofty educational mission.

MOLECULAR FIELDS OF FORCE: RETROSPECT AND SUGGESTIONS

By Prof. Sydney Chapman, F.R.S.,

Imperial College of Science and Technology

In the nineteenth-century development of the kinetic theory of gases, the molecules were at first usually treated as solid spheres like billiard balls, differing in size and mass. This molecular model, though it furnished a conveniently simple picture of many gas phenomena, nevertheless represented a retrogression from the model discussed long before by Boscovich[1], who regarded atoms as centres of force, varying with the distance r both in intensity and sign.

Maxwell[2], in 1867, made a partial return to the Boscovich model, when he gave the first mathematically accurate theory of the mean free-path phenomena of gases (namely, viscosity, conduction and diffusion), for a gas whose molecules interact according to the inverse fifth power of the distance, r^{-5}. This special law was chosen because its consequences are relatively easy to work out, within the brilliantly conceived framework of Maxwell's general method; not until 1915 was it found possible to adapt this framework so that any law of variation of the force $f(r)$, with the distance r, could be dealt with[3]. Soon afterwards the same results were achieved by Enskog[4], who overcame equal difficulties in generalizing a method due to Boltzmann, itself inspired by the work of Maxwell.

Meanwhile, in 1873, van der Waals[5] improved the solid-sphere molecular model by adding to it a field of attractive force; on this basis he developed his famous equation of state, the first great advance on the ideally simple Boyle-Charles law. Sutherland[6], in 1893, used the same model in connexion with the theory of gaseous viscosity.

Enskog and I, in our general theories of the mean free-path phenomena, dealt particularly with the simple force-law $f(r) \propto r^{-n}$, and with the van der Waals model. Lennard-Jones[7] first applied the theory to molecules of the Boscovich type, by taking $f(r) = Kr^{-m} + K'r^{-n}$; the first term represents the repulsive forces at short distances, and the other (if $K' < 0$) the attractions at long distances. He also calculated the equation of state for a gas composed of such molecules, and used both types of data (and others) to determine the force constants K, K' and the force indices m, n. He found that except in the case of hydrogen and helium neither the equation of state nor the viscosity determines the molecular field uniquely: for other gases the two methods permit a range of possible models (or values of K, K', m, n), and other methods have to be used to narrow this range.

The ambiguity of the models inferred by Lennard-Jones extends even to the sign of K', that is, it remains uncertain whether the distant field is attractive or repulsive[8]. Hence for many gases his formula for $f(r)$ may be regarded only as a means of indicating a change of the index of the repulsive field at moderate distances, instead of as representing the undoubted attraction at larger distances. If n itself is taken to be a function of r, any function $f(r)$ may be expressed as Kr^{-n}, over any range of r for which f has a constant sign; and $n = -d \log f(r)/d \log r$. For a particular temperature or range of temperature the important range of r at collisions will correspond to certain average values of K and n, and these values can be found as described, using formulæ based on the law $f(r) = Kr^{-n}$ (n constant); but K and n as thus determined will in general vary with the temperature.

Such methods of determining molecular fields of force, though based on accurate mathematical theories, are empirical in the sense that the theories merely indicate the observable consequences implied by the adoption of particular molecular models, and thus enable us, by comparing the theoretical results with experimental data, to infer more or less satisfactory models consistent with the data.

A more fundamental approach to the study of intermolecular fields is possible, by calculating them from the electronic structure of the molecules. The first step in this direction was taken in 1927 by Heitler and London[9], who applied the quantum theory to calculate approximately the interaction between two hydrogen atoms. Their theory accounted for the repulsion at small distances; in 1930 Eisenschitz and London[10] carried the calculation to a further approximation, and accounted also for the van der Waals force at large distances. The magnitude of this force was found with great accuracy, but the value of $f(r)$ for *atomic* hydrogen has comparatively little practical importance. The same methods have been applied also to helium atoms, and in this way Slater and Kirkwood[11], and later Buckingham[12], have obtained results in good agreement with one another and with the form of $f(r)$ determined empirically by Lennard-Jones. Calculations have also been made for other atoms, in reasonable agreement with observation.

For molecules the task is much more difficult; Massey and Buckingham[13] have made a beginning by calculating the long-range forces between hydrogen molecules. These forces will depend both on the distance r between the molecular centres, and on the orientation of their two axes relative to the line of centres, because the hydrogen molecule is not spherically but axially symmetrical. But Massey and Buckingham point out that in hydrogen at ordinary temperatures the time of complete revolution of a molecule is of the same order as the time of a collision, so that it is reasonably legitimate to average the interaction over all orientations; this gives the function $f(r)$ effective in gas kinetics, as if the molecules were spherically symmetrical.

Massey and Buckingham express the hope that they will be able to extend their calculations on the hydrogen molecule to include also the short-range forces, and thereafter to calculate the equation of state of hydrogen, and its viscosity, without recourse to empirical methods. But the day still seems far distant, as Fowler and Guggenheim remark in their "Statistical Thermodynamics" (p. 276), when such calculations will be a practical possibility, at least for molecules other than hydrogen. Hence our knowledge of molecular fields must for the present rest largely on their empirical determination from observed data.

An avenue to such knowledge, different from that followed by Lennard-Jones, and hitherto but little unexplored despite its promise, is afforded by the phenomenon of thermal diffusion[4,7], which is particularly sensitive to the nature of the molecular interaction. When a mixture of two gases (1, 2) is enclosed in a vessel, of which different parts are maintained at different (absolute) temperatures T, T', small differences of relative concentration are set up. The concentration difference is given approximately by $k_T \log_e(T'/T)$, where k_T, the thermal diffusion ratio, depends in a complicated way upon the mass-ratio and concentration-ratio and the three laws of interaction between either type of molecule (1,1 or 2,2), or between the two types (1, 2). Experiments in which k_T is determined have been made for many gas mixtures, by Dootson, Ibbs[14], Elliott and Masson, Lugg, Blüh, Nier and other workers; but the inferences drawn from these experiments, mainly as to the nature of the interaction between the unlike molecules, have hitherto been rather rough, partly owing to the complexity of the theoretical expression for k_T. It seems desirable, and through the great advance in our knowledge and use of isotopes it is now possible, to apply thermal diffusion more simply to the elucidation of intermolecular forces; this would also enable the considerable amount of existing thermal diffusion data to be interpreted better than is yet possible.

It is generally supposed, and the view is reasonably consistent with experimental data on viscosity, that the law of interaction $f(r)$ between two like molecules M is the same as that between M and an isotopic molecule M', or between two such molecules M'; for example, M may be H_2 and M' may be D_2, or M may be $C^{12}H_4$ and M' may be $C^{12}H_3D$ or $C^{13}H_4$. If this be so, the force-index n in the approximate expression $f(r) = Kr^{-n}$ may be determined from the equation of state or from the temperature variation of the viscosity; but a more delicate way of determining n is by thermal diffusion experiments on a mixture of the isotopic molecules, as has been done for $C^{13}H_4$ and $C^{13}H_4$ by Nier[15]. After n has been thus determined—and this can be done to a fraction of an integer, instead of with an uncertainty of one or more whole integers (as when viscosity data are used)—the corresponding value of K can best be determined from viscosity data at any particular temperature.

There is scope for a large amount of useful experimental work of this kind, especially in cases where more than one isotope is available, and particularly when one or more of these is radioactive. As an example, the case of hydrogen may be cited; it has two non-radioactive types of atom, H^1 (or H) and H^2 (or D), and one radioactive isotope H^3. O'Neal and Goldhaber[16] have lately shown that the half-lifetime of H^3 is 31 ± 8 years, so that this isotope is conveniently long lived. From these three isotopes six types of hydrogen molecule may be formed, namely, H_2, HD, D_2 (all non-radioactive), and HH^3, DH^3 and H^3H^3 (all radioactive); the last of these, however, is at present unlikely to be available in sufficient quantity for use in experiments. The remaining five types of hydrogen molecule provide ten different possible isotopic hydrogen mixtures, namely, (*a*) H_2–HD, (*b*) H_2–D_2, (*c′*) H_2–HH^3, (*d′*) H_2–DH^3, (*e*) HD–D_2, (*f′*) HD–HH^3, (*g′*) HD–DH^3, (*h′*) D_2–HH^3, (*i′*) D_2–DH^3 and (*j″*) HH^3–DH^3. The accent (′) in this enumeration indicates radioactivity in one or both components of the mixture; in such mixtures the radioactive molecules can at present be available only as very rare constituents, and therefore the last mixture, (*j″*), in which both constituents are rare, may be excluded from consideration. This leaves nine hydrogen mixtures available for thermal diffusion experiments. Those containing a rare radioactive constituent are very suitable for this purpose, as I pointed out in 1929[17], because of the delicacy of radioactive estimations; the difficulties which led to a high probable error in the half-lifetime of H^3, in the determination by O'Neal and Goldhaber, would not arise in thermal diffusion experiments; the temperature conditions can be maintained steady for a long time, and long-continued Geiger counts would permit the ratio of the concentration of the rare constituent in the two regions at different temperatures to be determined with considerable accuracy.

The nine hydrogen mixtures include one pair, (*h′*), or D_2–HH^3, in which the molecular masses are almost exactly equal; any thermal separation found for this pair (subject to a minute correction for the proportionate mass-difference $m \equiv (m_1 - m_2)/(m_1 + m_2)$, which is 5/8055) must be due to a slight inequality of the interactions between the D_2–D_2 and D_2–HH^3 molecular pairs; this provides a very delicate test of the supposition, already mentioned, that the force fields are identical for isotopic molecules.

For two pairs of the nine gas mixtures, namely, (*b*) and (*c′*), and (*e*) and (*f′*), the proportionate mass-differences m are almost identical, namely, $\frac{1}{3}$ and $\frac{1}{7}$ respectively; hence their thermal separations should be the same if the force fields are identical, and again this provides a delicate test of this identity; since in this case one mixture of each pair has no rare radioactive constituent, the thermal separation can be determined for a variety of concentration ratios, and an estimate made of the limiting value of k_T for a small concentration ratio of the heavier constituent (corresponding to the concentration of the radioactive constituent in the other mixture of the pair).

If these tests bear out the identity of the fields of force between different isotopic molecules, the interpretation of thermal separation data for other isotopic pairs is simplified, but in any event a complete set of such data, for these nine mixtures, in which the proportionate mass-difference m ranges from 0 to $\frac{3}{7}$, can be used to determine three constants[18], A, B, C, which appear in the formula for k_T, and which depend on the law of force at collisions between the *unlike* molecules of each mixture. If the force-law is $f(r) \propto r^{-n}$, these three constants are all known functions of n, and n can be inferred from any one of the three constants; if it were found that A, B, C do not all correspond in this way to one value of n, it would be proved that the force law is not of this simple form, and an indication would be gained as to how $f(r)$ diverges from this simple law.

The interpretation of such thermal separation data may require some extensions of the theoretical formula for k_T, offering no great difficulty. The combination of such theoretical and experimental work should lead to much more precise empirical knowledge of the field of force of hydrogen molecules than we now possess, and would be of value in testing further fundamental theoretical work on the hydrogen molecule.

Similar experimental studies might be made also on numerous isotopic mixtures for many other chemically elementary or compound gases, and would lead to a useful extension and a much increased precision in our knowledge of their fields of force.

---

[1] Boscovich, R. G., "Treatise on Natural Philosophy" (Venice, 1758).

[2] Maxwell, J. C., *Phil. Trans. Roy. Soc.*, **157**, 49 (1867).

[3] Chapman, S., *Phil. Trans. Roy. Soc.*, A, **216**, 279 (1916).

[4] Enskog, D., Upsala Dissertation (1917).

[5] Van der Waals, Leyden Dissertation (1873).

[6] Sutherland, W., *Phil. Mag.*, **36**, 507 (1893).

[7] Lennard-Jones, J. E.; for references see his chapter on Intermolecular Forces in R. H. Fowler's "Statistical Mechanics".

[8] See "The Mathematical Theory of Non-uniform Gases", by S. Chapman and T. G. Cowling, p. 228.

[9] Heitler, W., and London, F., *Z. Phys.*, **44**, 455 (1927).

[10] Eisenschitz, R., and London, F., *Z. Phys.*, **60**, 491 (1930).

[11] Slater, J. C., and Kirkwood, J. G., *Phys. Rev.*, **37**, 682 (1931).

[12] Buckingham, R. A., *Proc. Roy. Soc.*, A, **163**, 264 (1938).

[13] Massey, H. S. W., and Buckingham, R. A., *Proc. Roy. Irish Acad.* A, **45**, 31 (1938).

[14] Ibbs, T. L., *Physica*, **4**, 1133 (1937); also see ref. 8, Chap. 14.

[15] Nier, A. O., *Phys. Rev.*, **56**, 1009 (1939).

[16] O'Neal, R. D., and Goldhaber, M., *Phys. Rev.*, **58**, 574 (1940).

[17] Chapman, S., *Phil. Mag.*, **7**, 1 (1929).

[18] See p. 253 of reference 8.

SCREENED DUST AND ITS USES

By William B. Strain,
Inspector of Cleansing, Ayr

THERE is an old saying in agricultural circles in Scotland that you only take out of the soil what you have put in. To a greater or lesser degree this is correct, having regard to the elements necessary for supporting and maintaining the germination and growth of each particular plant.

Many factors contribute to the growth of a plant and most plants have their idiosyncrasies, as conversely there exist ideal conditions peculiar to the natural growth of particular plant life. Thus we have some districts of the country where potatoes grow best, others are better for carrots, beetroot, hay, oats, hops, and so forth. It therefore follows that in dealing with the fertilizer and its effects on plant life we must take into account the chemical and bacteriological condition of the soil, its physical characteristics, climatic conditions, etc. Nevertheless there are certain factors which must be present in all cases of plant cultivation, and of these, certain chemical elements are essential to plant growth.

When considering the use of screened dust therefore as a means of increasing soil fertility, we do not claim that it will grow any kind of plant, but at this particular time, when there is a need of fertilizers, screened dust forms a very useful, cheap and abundant means of conserving the better-known manufactured fertilizers specially suited to specific plants.

CONSERVATION OF FERTILIZERS

There is almost certain to be a shortage of imported fertilizers, and many manufacturers are searching around for some means of augmenting the anticipated shortage. Next year's crops must be raised and fed. Greater crops than ever must be grown by our own efforts. We cannot afford to risk importing either the fertilizer or foodstuff if the wherewithal to produce or grow them is already in our hands.

In almost every industry, business concern, farm and household throughout the length and breadth of the country we have in the past twenty years attained a sense of squandermania which is nothing short of sinful. Easily handled bags of fertilizers arrive on the farm which has been robbed of its organic requirements all these years. Many of the constituents of this fertilizer have been imported from foreign lands, thousands of miles distant; yet lying to hand, we have permitted city, town and country to dissipate organic matter and chemical elements amounting to millions of tons per annum. What then is the answer to waste ? It comprises one simple word—utilization. Everything must now be utilized and returned as raw or basic material to the particular industry requiring it. Manures or fertilizers are available in Great Britain in our so-called waste materials to the extent of hundreds of thousands of tons.

We must forget the economic aspect where the production of our food is concerned, as a sufficient quantity of food to meet war-time needs cannot be grown unless manures and fertilizers are produced from previously untapped sources within the confines of our own borders. Everything of manurial value should be utilized, and the following are a few sources with which I have experimented : (1) Sea wrack or sea-weed. Hundreds of thousands of tons of this valuable material go to waste annually. (2) Leaves from trees. There must be vast quantities of this material in the woods and forests of Great Britain. In my own town, forty tons were collected from the streets last autumn and the tonnage was only representative of trees overhanging public roadways. (3) Garden refuse. If separated into two classes (*a*) hard, and (*b*) soft, the former can be burned and valuable potash secured whilst the latter can be made into an excellent organic compound. (4) Damaged fruit. (5) Fish waste. (6) Night soil or sewage mixed with screened dust or other binding material. (7) Slaughter-house offals. (8) Existing refuse coups or tips where the household refuse has been disposed of for many years to an almost unbelievable extent. (9) Screened dust.

From these nine sources alone, hundreds of thousands of tons of valuable material can be obtained and rendered suitable for growing our foodstuffs either by one of the many manufacturing processes already existing or by the aid of Nature herself. A great deal of study and progress has been made in the past few years and the authorities concerned could easily be brought together to organize the collection, treatment, and disposal to agriculture of these so-called waste materials which are lying dormant. To illustrate what can be done with so-called waste material, I undertook research work in collaboration with the Hannah Dairy Research Institute, Ayr, on the subject of a very lowly material now well known as screened dust. This material consists of the very fine riddlings of household refuse which will pass a 5/16 riddle.

For many years it had been used for opening up heavy clay soils or mixed as a binder with slaughter-house offals in many parts of the country, but there was a lack of information obtained under the control or direction of competent authorities. The experiments were therefore undertaken to discover the true value of the material, and a fascinating period of study revealed that the grey dusty material had many very interesting characteristics peculiar to it.

To begin with, it was discovered that screened dust is comprised almost entirely of fine ash from household coal, which is only partly burned out because of the lamentable inefficiency of the everyday household fire. It therefore retains a good number of the qualities of coal itself.

Source of Supply

Screened dust is obtained from the household refuse and has to be riddled through a 5/16 and ¼ in. screen to obtain it free from glass. The refuse should also be passed over a small magnetic separator so as to eliminate the possibility of foreign matter such as pins, nails, razor blades, etc. The household fire is therefore the homely source from which we receive screened dust among the household ashes. It is very finely divided, for the greater part less than ¼ in., and much of it is a very fine powder of particle size. It can be mechanically riddled to a fine consistency of good appearance.

Application to Farmlands

Applications of five tons per acre or slightly more give excellent results on sandy soils, loams, clay loams, heavy clay, and even poor sandy soil, and particularly on land which has a tendency to acidity. The material is usually broadcast by a shovel from a cart; but some farmers now desire to spread screened dust by a manure-sowing machine. An alternative method is the use of a road gritting machine.

The material acts both mechanically and chemically on soil—opening up heavy land, allowing aeration and supplying food to the plant.

Crops which will Benefit from Screened Dust

Timothy, rye grass, cocksfoot, backward clovers and mixed hay crops are improved by the use of screened dust. The straw or stem is of a much harder and better keeping quality than similar crops manured with farmyard manure. In some cases timothy hay has been observed to grow twice to three times more hay than with the normal dressings. Where seeding of timothy and rye grass hays have taken place, the seeds have been well filled and much heavier by weight than in other or the same fields on the farms concerned which had been manured by other means.

Pasture land and clover respond well to screened dust. Oat crops treated with screened dust withstand heavy weather much better if in an exposed position. Some excellent crops have been grown in this way. Turnips, cabbage, mangold, potatoes, lettuce and like crops grow well when screened dust is applied to the soil. Last year's experiments with mangold showed that the seeds sown in screened dust itself, laid to a depth of five feet with no soil present, saw a good crop of mangold through all the stages of growth. Thus it was proved that screened dust itself has all the properties present to propagate and support plant life without assistance of any other soil or fertilizer. This can be safely vouched for, as evidenced by the very vigorous growth of all kinds of plants in a field near Ayr which is covered to a depth of one foot with screened dust.

Temperature Increase of Screened Dust

A considerable increase of temperature takes place when screened dust is laid in a heap of three feet deep. The temperature over a period of four to six days after screening may attain 150° F. to 160° F. Thus a certain degree of sterility can be assured if the dust is allowed to lie in heaps for six days after being screened.

Presence of Organic Matter

The percentage of organic matter present in screened dust is surprisingly high and varies between 13 and 35 per cent, and if the recommended dressing of five tons per acre is adhered to, a liberal amount of organic matter will be applied, much of which seems readily available for plant food.

Trace Elements

An examination of screened dust was undertaken by the Macaulay Institute, Aberdeen, to which I am indebted for the information contained in Table 2.

The importance of the trace or minor elements in agriculture has been stressed during the past few years both in Great Britain and abroad. In any manurial treatment of soil for crops it is essential that, together with the application of such well-known fertilizers as the nitrogenous, phosphatic, potassic and lime varieties, attention must be paid to any possible minor element deficiency, otherwise unsatisfactory crops may be obtained. Such crops may be unsaleable, give an uneconomic return, or have a serious effect on animals fed with them.

Table 1. Analysis of Dust.

Sample No.	Nitrogen	Water	Organic matter	Ash	Analysis of ash expressed as percentage of total sample				
					SiO_2	$Fe_2O_3+Al_2O_3$	CaO	P_2O_5	Sulphur
A	0·374	18·9	20·1	61·0	32·7	11·7	6·58	0·28	2·09
B	0·434	9·8	17·7	72·5	39·7	9·2	10·66	0·27	2·02
C	0·428	8·4	18·8	72·8	38·5	9·3	9·05	0·27	2·02
D	0·419	16·2	24·8	59·0	37·6	9·4	7·79	0·18	0·86

Of the minor elements perhaps most importance has been laid on boron, iron and cobalt. It seems evident from well-controlled experiments that the disease of turnips, known as 'raan', can be eradicated by the application of dressings of small amounts of boron to the soil. Further, in cases where raan was not found to any large extent, an increase in the total weight of turnips per acre was noted. Similarly, with sugar beet, the yield was markedly improved and the incidence of heart rot was considerably lowered when boron compounds were applied before sowing the seed. With cobalt the effect of a deficiency is not apparent in the plants, but becomes evident when these are fed to animals.

Table 2. Trace Elements. Spectrographic Examination of Sample of Refuse Dust.

Present in quantity	Present in small quantity	Present in large trace	Present as trace	Present as slight trace	Not observed
Silicon	Manganese	Boron	Germanium	Arsenic	Cadmium
Aluminium	Vanadium	Lead	Tin	Rubidium	Mercury
Iron	Potassium	Copper	Molybdenum	Caesium	Gold
Carbon		Zirconium	Silver	Zinc	Ytterbium
Phosphorus		Beryllium	Chromium		Antimony
Titanium		Cobalt	Gallium		Bismuth
Calcium		Nickel			Indium
Magnesium		Barium			Thallium
Sodium		Strontium			Scandium
		Lithium			

In Australia and New Zealand certain sheep diseases, which eventually result in the death of the animals, have been shown to be due to a deficiency of cobalt in the soil and plants. More recently in Great Britain a cobalt deficiency disease of live-stock has been discovered, a disease which can be effectively eradicated by the application of cobalt salts to the pasture on which the animals graze. Similarly with every one of the minor elements, we find that at least a trace is essential for the production of good land, sound, healthy crops, and healthy live-stock. As will be seen from Table 2, screened dust supplies all the known important minor elements in considerable quantity and the others in smaller amounts. Screened dust, therefore, is about the only fertilizer in use to-day which supplies all these elements in one dressing.

For the removal of decayed grass known as fog or the elimination of moss on lawns, screened dust is of great assistance. Good results have been obtained in kitchen gardens, potting and carnation growing. Many more fields of exploration are open, such as application to golf courses presently being used for grazing sheep and so forth. Amateurs and professionals alike can profitably experiment with the ash, direct from the household fires and passed through a ¼ in. riddle.

For potting or framework, one part screened dust to six parts soil can be recommended for opening up a stiff soil.

OBITUARIES

Dr. C. H. Merz

Our deepest sympathy goes out to Mrs. Merz on the tragic death of her husband, Dr. C. H. Merz, and their son and daughter who were victims of recent enemy action; a maid and chauffeur, who had been their devoted servants and loyal friends, died also in this attack.

Charles Hesterman Merz was born at Gateshead-on-Tyne in 1874. He was the son of the late Dr. J. Theodore Merz, the learned author of the "History of European Thought in the Nineteenth Century". His mother was Alice Mary, daughter of Mr. Edward Richardson, of Newcastle-on-Tyne, who belonged to a well-known Quaker family. He was educated at Bootham, York, and received his technical training at Armstrong College. Electric power and railway traction schemes all over the world bear witness to his work. In 1898, after training and experience at Newcastle, Lincoln, London, in Ireland and other places, Merz acted as engineer for the promotion of a Bill for supplying electric power to works and shipyards on Tyneside. This was the first of the 'power bills'. Afterwards he acted as engineer for the first company to use three-phase distribution in England at the then high pressure of 6,000 volts. In 1900 the company amalgamated with the Newcastle-upon-Tyne Electric Supply Company, and the combined undertaking (now the North Eastern Electric Supply Co., Ltd.) expanded during the succeeding eight years, until it covered Northumberland and Durham and parts of Yorkshire. This involved the first large-scale use of 20,000-volt underground cables, and the first extensive use of high-voltage overhead lines in Great Britain. Neptune Bank Power Station, which Merz designed, was commissioned in 1900, and was the first to use large Parsons turbo-alternators. About this time Merz took into partnership William McLellan, who had been associated with him in all his work at Tyneside; this partnership continued until McLellan's death in 1934.

In 1907 Merz visited Australia to advise the Victorian Government on the introduction of electric traction. He laid down the basis of the legislation and organization adopted for the control of the power industry in Victoria. In 1909 he visited the Argentine and reported on the adoption of electric traction in the neighbourhood of Buenos Aires. In 1913 he visited India on the invitation of the Government of Bombay and reported on the electrification of the suburban railways. He was retained in an advisory capacity by the Commonwealth Edison Co. of Chicago, and was responsible for large railway electrification schemes, including the conversion of the South African railways and the Great Indian Peninsular Railway. He compiled the technical report for the Weir Committee which investigated the question of main line electrification in Great Britain.

During the War of 1914–18, Dr. Merz was director of Experiment and Research to the Admiralty, and within the same period served on the Haldane and Williamson Committees, which recommended the appointment of the Electricity Commissioners. In 1925 Merz put before these Commissioners a memorandum which resulted in the appointment of the Weir Committee, the report of which led to the Act of 1926 setting up the Central Electricity Board and to the construction of the Grid. At Sir Andrew Duncan's request, Dr. Merz was to have placed gratuitously his great and varied experience at the service of the Ministry of Supply from October 28 of this year.

In 1913, Merz married Stella A. P. Byrne, daughter of Mr. Edmund de Satur, of Dublin, and had one son and one daughter. He was a vice-president of the Institution of Electrical Engineers during 1912–15, and was awarded the Faraday Medal in 1931. In 1932 he received an honorary D.Sc. from the University of Durham. He was a member of the Institution of Civil Engineers and various other technical societies and was also a fellow of the American Institute of Electrical Engineers. All who knew him feel that one of Britain's great men has been taken from us, and those who knew him best feel it most.

Alexander Russell.

Dr. M. Mathisson

The death of Dr. Myron Mathisson on September 13 at the early age of forty-three has cut short an interesting line of research. Mathisson had been engaged for many years in studying the general dynamical laws governing the motion of a particle, with possibly a spin or a moment, in a gravitational or electromagnetic field, and had developed a powerful method of his own for passing from field equations to particle equations. The subject is of particular interest at the present time, as it has now become clear that quantum mechanics cannot solve the difficulties that arise in connexion with the interaction of point particles with fields, and a deeper classical analysis of the problem is needed. It is much to be regretted that Mathisson's death has occurred before the relations between his method and those of other workers on the subject have been completely elucidated.

Mathisson carried out his work at the Universities of Warsaw and Kazan and at an institute which he started in Cracow, and, since the spring of 1939, at Cambridge.

P. A. M. Dirac.

We regret to announce the following deaths:

The Rev. W. G. Ivens, an authority on Melanesian languages.

Sir Herbert Wright, treasurer of the Imperial College of Science and Technology, an authority on tropical agriculture, especially rubber, on October 28, aged sixty-six.

NEWS AND VIEWS

Mr. Franklin D. Roosevelt

THE election of Mr. Roosevelt as President of the United States for a third term of office, though by no means unexpected, will be accepted by onlookers as the strongest endorsement of the policy he has followed in the present world conflict. Not only has he consistently pledged the American people to full support of the Allied cause in the interest of the democratic ideal, but also he has secured that practical effect should be given to that pledge by bringing the vast material resources and industrial power of his country to bear upon the problem of supplying the needs of the Allies for the munitions of war, so far as compatible with the requirements of America itself for purposes of defence. It cannot be doubted that in casting their vote for Mr. Roosevelt, notwithstanding that no president hitherto has served more than two terms of office, the American people have been profoundly affected by their appreciation of the necessity of placing beyond question continuity of policy in the assistance afforded the Allies. On one hand, the President's reiteration that America's effort shall be the maximum, short of war, secures, as Mr. Joseph Kennedy has pointed out, that supplies shall suffer no diminution through arming American forces on a basis other than for purposes of defence. On the other hand, Mr. Roosevelt has so framed his policy and that of the political party of which he is the leader and the representative as to secure, both now and possibly even more in the future, a maximum of co-operation between the democratic peoples of the Americas outside the United States with those who are now engaged in a life and death struggle for the continued existence of democracy in the Old World.

German Culture in Czechoslovakia

THE Czechoslovak National Council has just issued a publication, "German Cultural Oppression in Czechoslovakia" (London: Allen and Unwin, 6*d*.), outlining the position in the protectorate of Bohemia and Moravia. Oppressive measures began after the Munich "agreement" of 1938, whereby a million Czechs in the ceded territories lost their scientific and technical institutions and places of higher education and culture. Pressure was simultaneously brought to bear upon the still nominally independent Czech Ministry of Education to eradicate Jewish and other "undesirable" elements in the universities. After the German entry into Prague in March 1939, all cultural work and scientific research came to a standstill. All Government departments and local administration passed into German hands and since that time the *furor teutonicus* has raged against all the intellectual activities of the nation. A Nazi censorship spent months purging libraries of every book or journal containing any reference distasteful to its narrow doctrines. Concurrently with this, books and valuable apparatus were removed from Czech universities, scientific institutes and museums and were either sent to Germany or wantonly destroyed.

These activities were followed by the massacre of Prague students in November 1939, an act attributed to the students' own disturbances, which "necessitated" the closing of all Czech universities, medical schools and establishments of higher education. It is established that a hundred and fifty students were executed, whilst the total deaths (including university lecturers and secondary schoolmasters) amounted to more than a thousand. In addition, no fewer than seventy thousand intellectuals, students, authors, etc., were imprisoned or sent to German concentration camps. Those who escaped arrest have been persecuted in other ways. All contact with the rest of the world was prohibited, and at best these savants have lost their means of livelihood through the closing of the universities. These activities form but a small part of the systematic Nazi oppression in countries now under German rule, but they cannot be passed over in silence. Men of science and learning throughout the world will condemn heartily such conduct towards a courageous people whose high intellectual standard may be inferred from the fact that theirs is the lowest percentage of illiterates in the world.

Egyptian Bird Observations

THE extension of the theatre of war for the winter campaign in Egypt with the presence of a large Allied Army in the Nile valley affords much opportunity for ornithologists on active service in all ranks in the Near East, and recalls the numerous and important field observations on British birds and migrants in Egypt made by Army men during the War of 1914–18. Since von Heuglin surveyed Egyptian bird-life in his epic work on north-east Africa, and Shelley produced his book on Egyptian birds, Colonel Meinertzhagen in 1930 produced under the authority of the Egyptian Government a two-volume collection of Nicolls' records of birds of Egypt. The Giza Zoological Gardens where Nicolls worked and collected are still visited by waterfowl like the shoveller. Demoiselle and great cranes gather by the thousands on the banks of the Nile. Jack snipe from northern Europe are winter visitors, while great egrets, wood ibis, sandpipers and numerous ducks and waders complete the bird-life of the Nile valley. Curlew, redshank, grey plover, dunlin, spur-winged plover, shoveller, mallard, teal, pied kingfishers, kestrels and marsh-harriers are among the bird-life of the royal estate at Dahshur.

In winter and early spring, huge congregations of birds are always to be seen beside the White Nile and south of Khartoum. White- and blue-headed wagtails are very numerous, along with wheatears, shrikes, pipits and a wealth of raptorial birds such as peregrines, red-footed falcons, hobbies, Montague's harrier, etc., and of waders like godwits, stilts, green-, wood- and curlew-sandpipers, Kentish plovers and of duck such as pintail, garganeys and a few widgeon. There are common, purple, squacco and night herons, spoonbills, storks, glossy ibises, singly or in great flocks, trips of ruffs by the water, swallows, house-martins, sand-martins and swifts over the water. Most of these birds may be seen passing through Egypt by the Nile or down the Suez Canal, where the Kentish plover nests on the marshes. In north Egypt in winter may be seen such British birds as song thrushes, robins, blackbirds, starlings, skylarks and lapwings in some numbers.

Earthquakes in Rumania and Turkey

On October 22 earthquakes shook many districts in Rumania and Turkey. Earthquake tremors of medium intensity were registered in Bessarabia, Kieff, Kharkoff and elsewhere in the Ukraine, apparently coming both from the Carpathians and the Caucasus. On the same morning about 8.30 a.m. (local time) a severe shock was felt at Barlag close to Basau near the Carpathians, where children were injured and one boy killed when the roof of a school collapsed. Many other houses were damaged, and some people were unable to stand at the time in the streets. In Bucharest the shock is said to have been the most severe for many years. It is reported to have been a double shock, of total duration according to human perception of about thirty seconds, and to have caused considerable cracks in several stucco buildings besides breaking windows and shaking movable objects (modified Mercalli scale VII). No one was injured in the capital.

Apparently about the same time as the Rumanian shocks the Turkish port of Smyrna was rocked by a severe earthquake, though no serious damage or casualties have been reported. It appears unlikely that the shakings in Rumania and Turkey were due to the same earthquake as surface waves of moderate intensity are soon damped out. Further information from the seismological observatories is awaited before the exact times and epicentres of the shocks can be worked out. Earthquakes in all these regions are not uncommon. Prior to being affected by the great Anatolian earthquake of December 26, 1939, Smyrna was seriously damaged by earthquakes on March 31, 1928, and on September 20, 1899.

Electrical Engineers and the War

In his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. R. Beard, of Messrs. Merz and McLellan, gave first a short account of the war-time activities of electrical engineers, and then made many thoughtful comments on the planning of the post-War world. He said that in this War, engineering, technological and scientific problems are playing a greater part than ever before, and that the many branches of electrical engineering have all been directly or indirectly engaged in war activities. The Institution of Electrical Engineers has now the largest membership of any British professional institution. During the past year, the membership has exceeded 20,000 and its responsibilities are correspondingly great. He mentioned particularly the strenuous work undertaken by those engaged in the light current branches. These include such vital services as communications and broadcasting, and the design and manufacture of the apparatus for them and of the similar apparatus for the rapidly expanding needs of the Royal Navy, the Army and the Royal Air Force. In particular, those engaged upon research and development in the multifarious new applications of wireless deserve special record.

Some 1,285 members of the Institution are on active service with His Majesty's Forces, but, unlike the position in the War of 1914–18, almost all of these are engaged in a technical capacity which makes use of their specialized knowledge. The bitter experience of 1914–18, when so much technical talent was wasted through trained men being drafted from productive work into non-technical units, was fortunately taken to heart in good time. Some time before the War broke out, the Ministry of Labour organized the schedule of reserved occupations. On the whole, this has functioned admirably. The Institution has always taken pride in the number of its overseas members, which now amounts to one fifth of the total membership. For many years there have been local centres in the Argentine and China, and there are sixteen local honorary secretaries and twelve overseas committees in many parts of the world. These are an invaluable liaison between distant members and headquarters. Much attention has been given to increasing these contacts with the engineering institutions in the Dominions and India. At a time when the joint defence of our liberties in face of the assault on all free peoples is forging still closer the links of the British Commonwealth of Nations—and indeed of all English-speaking peoples—Mr. Beard reminded members of the Institution overseas that their share in the war-time activities of our various countries is in no way less important than the work of members at home, and that this is recognized and appreciated. Plans for yet closer collaboration after the War are eagerly anticipated.

Early Harbour Engineering

In his presidential address to the Institution of Civil Engineers delivered on November 5, Sir Leopold Saville said that since the branch of engineering with which he had been principally associated was harbour engineering, he proposed to deal with harbours from the dawn of written history to the early days of the Roman Empire. He reviewed first the development of the four harbours of Alexandria, namely that of A-ur, about 3000 B.C.; the great harbour of Pharos, soon after 2000 B.C.; the harbour of Alexander the Great, begun in 332 B.C.; and the modern harbour, A.D. 1870. He then turned to the pre-Hellenic harbours of Tyre. By 1400 B.C. the renown of the city was widespread, and by 1100 B.C. its seamen had passed Gibraltar and had dared the Atlantic. It was probably about that time the Sidonian harbour was built; Hiram, king of Tyre (970–936 B.C.), built the

Egyptian harbour. In Greece, deep bays and long arms of the sea made excellent natural harbours; moreover, Greece was divided into many small States, each with its own port. Athens used first the broad open bay of Phalerum, where ships were beached in sight of the city. That arrangement, however, had several strategical and navigational disadvantages, and in 493 B.C. Themistocles persuaded the Athenians to develop the fine natural harbour of Piræus. At some places artificial harbours had to be constructed, of which that at Eleusis was typical.

The Romans had to face difficult technical problems when their growing commerce demanded effectual shelter. They introduced many new methods, the most outstanding of which were the use of the arch, the cofferdam, hydraulic cement (pozzuolana), and the driving of piles in deep water. The Roman ideal plan was an artificial harbour having the two incurving breakwaters of the Greeks, with the Roman addition of a short protecting mole or island breakwater in front of the entrance. The sand problem caused considerable trouble, and silting drove the Romans from Antium and the Tiber and caused the failure of the harbour of Ostia. Trajan accordingly took measures to provide a new harbour for Rome higher up the coast, which under its modern name of Civita Vecchia is now the principal port of Rome. The Roman Empire was followed by more than 1,000 years of acquiescence, or even retrograde action, in harbour engineering, and it was not until the engineering revival in about the middle of the eighteenth century that such ambitious schemes were again attempted.

Electric Fan Ventilation

THE necessity for air-raid precautions and for black-outs has introduced several problems besides that of lighting which have to be studied. In the *Electrician* of October 11 a discussion is given of some important considerations with respect to electric fan ventilation. One attendant result of most of the measures taken for black-out and sandbagging against the effect of bombing is the restriction of the natural air-flow and an increase in the heat dissipation due to augmented lighting. Since it is known that a relatively high proportion of carbon dioxide can be permitted without any ill-effects, in big ventilation systems a large percentage of the air is recirculated in order to conserve the heat. Hence where the volume of air relative to the number of persons concerned is large, an air disturber serves a useful purpose in both summer and winter. In smaller places the most usual method of ventilation under ordinary peace conditions is by exhaust, but it is now common to take into consideration the presence of gas from enemy action, and for such eventualities it is necessary to take in a supply of clean air by means of an intake placed so as to be above the level likely to be contaminated. Complete protection is afforded by first passing the air through a filter.

The number of air changes required in various public buildings is laid down by law, but for offices, shops, factories, etc., the figure depends on the work to be carried out and the types of processes involved. For the average type of office, two to three air changes an hour will be sufficient, for dining-rooms four to six, but for kitchens fifteen to twenty changes may be necessary. Where long runs of ducts are necessary for extracting from a number of rooms, the resistance of the air in the ducts may be more than a propeller fan can deal with, and a centrifugal fan should be used.

Primitive Trepanning

THE surgical operation of removing a circular piece of bone from the human skull of the living is one which it has long been known was practised by primitive man with, relatively speaking, some frequency. The practice had a wide distribution in both time and space, ranging chronologically from the early neolithic period to modern times and geographically from many parts of prehistoric Europe (and in historical times in Serbia) to the Pacific. Late prehistoric or early historic examples are known from the Caucasus, Palestine and Siberia, while the practice was frequent in pre-Inca and Inca Peru and Bolivia. In the last-named region, however, there is a possibility that there has sometimes been confusion with a syphilitic lesion. The frequency of a depressed fracture in a stone age culture using the stone axe as a favourite weapon must, obviously, be held responsible for the introduction of the operation; but there is evidence that it was also employed for the alleviation of any violent pain in the head. A variant practised for the relief of headache in New Guinea is drilling with a boco-drill and flint fleam. The appearance of amulets made of circular pieces of bone taken from a trepanned skull, which are among prehistoric finds, points to the infiltration of magical ideas—never long unobserved in primitive methods of healing—and affords an explanation in part for the performance of the operation at or after death.

The uniformity in the technique of the operation, the cutting of a circular groove with a stone implement, or rarely a series of drill holes, or grooved straight lines forming a rectangle—suggests the possibility of its distribution by cultural diffusion. Mr. Stuart Piggott, however, in a study of the practice in prehistoric Europe, to which reference is made on p. 621, holds the view that in its earliest appearances when it is a remedial measure for individual injury it is to be regarded as an independent invention, but that when it becomes a cult —a justifiable reference from the evidence—we are justified in looking for links between instances in which the rite was practised. Working from the early centre of greatest frequency in the Lozère valley of southern France and ingeniously associating the rite of trepanation with megalithic building and the cult of the megalithic goddess, he traces it to the mouth of the Garonne along the line of the Bronze Age trade route along the oolite and to the Paris basin, whence it spread with the SOM culture characteristic of that area in this period.

Primitive Irrigation in South-Western U.S.A.

The south-western regions of the United States of late years have won a prominent place in archæological news as a source of evidence of earliest man, the hunter, on the American continent. It had been known for some considerable time, however, that the arid lands of Utah, Colorado, Arizona and New Mexico were the seat of the so-called Pueblo civilization, which had produced not only the remarkable cliff dwellings found in the Pueblo villages, but also that these villages are among the oldest known agricultural settlements in the United States. There sedentary farmers practised a specialized form of agriculture with maize as its main crop. Notwithstanding the varied topography of these arid regions, the farmers had a common interest and preoccupation —the problem of irrigation. So successful were their methods that, in 1540, when Coronado reached Hawikuh, the most southerly of the "Seven Cities of Cibolu", the villages were able to supply him with sufficient corn to support his three hundred and twenty men and their native carriers for a period of two years.

At this early date, the mode of life and agricultural system had been so long established that not only had early sites of settlement been abandoned on a large scale, but also one of the most important groups of Pueblo villages, that of Mesa Verde Plateau, discovered in 1888 and now a national park, had been given up so long before the coming of the Spaniards that it receives no mention in any of their narratives. The overwhelming importance of rainfall in the life and thought of the early Pueblo peoples may be gauged from the ritual and methods of present-day Hopi and Zuñi tribes, which preserve the tradition, probably with little change, while evidence of the elaborate and skilfully devised irrigation system is still available on the ground as material for a reconstruction (see Nature of November 2, p. 591).

Cancer in an Oil Refinery

The issue of *Public Health Reports* for August 23 contains an interesting paper by William M. Gafafer, senior statistician, and Rosedith Sitgreaves, of the United States Public Health Service, on disabling morbidity and mortality among the male employees of an oil refining company with reference to age, sex and duration from 1933 to 1938 inclusive. During this period a total of approximately 60,000 years of membership for male employees yielded 70 cases of cancer of which 46 were fatal. These cases included five which began in 1932 and ended in 1933, but excluded four which began in 1938 and were carried over into 1939. The cases which did not end in death terminated in recovery or sufficient improvement to return to work. The employees of the oil refinery showed relatively more cancer of the digestive tract than occurred among the total population, while the proportion of cancer of the genito-urinary tract was much less. The two sites—stomach and other abdominal organs—accounted for more than half the cases, and each specific site showed increases with age with respect to both frequency and mortality. For all ages the ratio of cases to deaths was less than 1·2 in three sites, namely, the œsophagus, stomach and other abdominal organs. Cancer of the lung showed the largest average case duration as well as the largest average duration of non-fatal cases.

Vitamin B_1 in Bread

The Minister of Food has appointed the following committee, which includes representatives of the flour milling industry and the baking trade, for consultation with the Ministry on the administrative and technical questions associated with the introduction of synthetic vitamin B_1 and calcium into white flour: Mr. H. D. Vigor (chairman), Mr. Edmund B. Bennion, Mr. W. Bloor, Prof. E. C. Dodds, Mr. T. H. Hodgson, Prof. R. A. Peters, Mr. J. Arthur Rank, Mr. Arthur Robinson and Dr. J. Sword.

Announcements

Prof. D. L. Savory, professor of French and Romance philology, was returned unopposed in Belfast on November 2 as Unionist member for Queen's University in the British House of Commons in succession to Colonel Thomas Sinclair, who resigned after holding the seat since 1923.

Ministry of Transport returns show that 578 persons were killed in road accidents last July as compared with 554 in July 1939. Only 115 of these deaths occurred during the black-out hours, and adult pedestrians and cyclists were mostly affected, 132 and 107 deaths respectively being registered in these groups.

At the annual statutory meeting of the Royal Society of Edinburgh held on October 28, the following officers were elected: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Dr. Leonard Dobbin, Mr. J. A. Inglis, Prof. R. Stockman, Prof. James Ritchie, Dr. G. W. Tyrrell and Prof. C. T. R. Wilson; *General Secretary*, Prof. James P. Kendall; *Secretaries to the Ordinary Meetings*, Prof. R. J. D. Graham and Prof. W. M. H. Greaves; *Treasurer*, Dr. E. M. Wedderburn; *Curator of the Library and Museum*, Dr. J. E. Mackenzie.

The Council of the University of Leeds, on the recommendation of the Brotherton Collection Committee, has gratefully accepted a bequest by the late vice-chancellor, Sir James Baillie, of his private note-books consisting of twelve volumes of philosophical reflections written during 1894–1937 and entitled "Privatissima", together with other unpublished manuscripts, printed papers and a rare photograph of Hegel. In accordance with Sir James Baillie's expressed wish, the papers will be deposited and kept in the Brotherton Collection Rooms, and no part of the contents of the "Privatissima" will be published within ten years from the time when they came into the possession of the University.

In the paragraph headed "Trephining in Great Britain" in Nature of September 28, p. 433, the reference to a paper on trephining in New Britain is incorrect; the correct reference is "Rev. J. A. Crump and V. Horsley, *J. Anthrop. Inst.*, **31**; 1901".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Terminology of Relative Growth-Rates

For many years past, biologists have been interested in the rates of growth of parts of organisms in relation to the whole or to other parts. Such ratios were termed by Huxley[1] *constant differential growth-ratios*, and the whole process by Pezard[2] *heterogony*. The process may obviously be either positive, if the relative size of the part increases with time (that is, grows more rapidly than the whole), or negative, if the relative size diminishes (that is, grows more slowly). If it attains an extreme degree, it might be called, in Champy's phrase[3], *dysharmonic growth*. Some authors, for example, Teissier[4] (who, with Needham[5], introduced the application of these concepts to the chemical constitution of the body) at first adopted this usage; but it has not proved acceptable, since, if we liken the organism to a piece of music, the growth of all parts at the same rate would be unison, and their growth at different rates harmony, not disharmony. Later, after the term *heterogony* had come into very general use, Huxley and Teissier[6] proposed its replacement by *allometry* on the ground that heterogony had previously for a long time been employed by sex physiologists to denote a special type of reproductive cycle.

The term allometry was considered by Huxley and Teissier to be advantageous in that it could be applied both to phenomena of growth and to phenomena of proportionate size. Since terminology, which does not distinguish between differences during growth, at any given stage of growth, or after its completion, is bound to lead to ambiguous interpretation in many instances, the advantages of an all-embracing term are doubtful. Furthermore, *heterogony* after all implied something inherent in the developmental plan of the organism, while *allometry* seems to refer only to our metrical methods. Hence we welcome a suggestion to one of us (J. N.) by Dr. Arthur L. Peck, of Christ's College, Cambridge, that for relative *growth*, in contradistinction to relative *proportions*, the word *heterauxesis* should be used, with *isauxesis*, *bradyauxesis*, and *tachyauxesis*, for the three cases formerly known as isogony and negative or positive heterogony. It is true that the terms auxesis, heterauxesis, ectauxesis, endauxesis, etc., were formerly employed in plant physiology[7], but they have long been obsolete there. On the other hand, botanists do still distinguish between *auxesis* or growth by expansion, and *merisis* or growth by cell-multiplication, a usage which enhances the suitability of the term heterauxesis for all dimensional and chemical differentiation.

Comparisons may be made between organisms of the same group differing in age, size, weight, chemical composition, etc.; this is *heterauxesis*. But comparisons may also be made between organisms of different groups (races, varieties, species, genera, and the like) differing in size or other qualities but of the same age, for example, birth or adult maturity. We suggest that the word *allometry* and its attendant *isometry* should be reserved in future for this. In many such cases the Huxley equation holds good; for example, the relation between egg-size and bird-weight (in his book[1]), or the work of Hersh[8] on titanotheres, or Lumer on skeletons of dog races[9], or that of one of us (I. M. L.) on gluathione in different races of rabbits at birth (Lerner, Gregory and Goss[10]). The word *allometry* has been used in a similar sense by Osborn[11], who thus described evolutionary changes in bodily proportions. The co-ordinate distortions of d'Arcy Thompson[12] would thus be said to represent allometric differences. The exponent in the allometric relations may be called the *limiting equilibrium constant* or *ratio* in accordance with the suggestion of Huxley and Teissier[6]. In the case of heterauxesis *actual equilibrium constant* or *growth-ratio* may be used. Similarly, *enantiometry* should be distinguished from *enantiauxesis*.

We venture to hope that these suggestions will be widely approved, and would propose that the distinctive usage of these terms be in future generally adopted. Such a practice would eliminate confusions which undoubtedly occur at present between the two types of comparison.

Joseph Needham.
University of Cambridge.

I. Michael Lerner.
University of California,
Berkeley, California.

Sept. 2.

---

[1] Huxley, J. S., "Problems of Relative Growth" (London, 1932).

[2] Pezard, A., *Bull. Biol. Fr. and Belg.*, 52, 1 (1918).

[3] Champy, C., "Sexualité et Hormones" (Paris, 1924).

[4] Teissier, G., *Trav. Stat. Biol. Roscoff* 9, 27 (1931).

[5] Needham, J., *Biol. Rev.*, 8, 180 (1933).

[6] Huxley, J. S., and Teissier, G., Nature, **137**, 780 (1936).

[7] Roux, W., Correns, C., Fischel, A., and Küster, E., "Terminologie der Entwicklungsmechanik" (Leipzig, 1912).

[8] Hersh, A. H., *Amer. Nat.*, 68, 537 (1934).

[9] Lumer, H., *Amer. Nat.*, 74, 439 (1940).

[10] Lerner, I. M., Gregory, P. W., and Goss, H., *Proc. Soc. Exp. Biol. and Med.*, 35, 283 (1936).

[11] Osborn, H. F., *Amer. Nat.*, 66, 52 (1932 .

[12] Thompson, d'Arcy, "Growth and Form" (Cambridge, 1917).

Attraction Fields *in Vitro*

In unpublished researches of Fardon, Sullivan and Andrus[1], a series of experiments were conducted showing the outgrowth of cells from traumatized sections of embryonic chicken intestine *in vitro*. It was observed at the time that the new outgrowth of cells aligned itself into uniform patterns. The nature of the outgrowth was analogous to the fields surrounding a bar magnet. This uniform distribution of cells served to indicate a force of attraction between the two portions of outgrowth.

Later, during the course of experiments with embryonic chicken heart, two fragments were introduced into the plasma drop of a slide culture quite by accident. When growth measurements were made eighteen hours later, a peculiar phenomenon was observed in the culture containing the two fragments. A very definite field of attraction was found to exist between the two pieces of growing tissue. Though this attraction field reminded us of the earlier experiments with embryonic intestine, the field itself was made visible through what appeared to be slight differences in the refractive index of the plasma clot. In some respects the rays or streamers in the plasma resembled the iron filing pattern produced by a magnet. Though some cells had already migrated from the tissue fragments, the rays visible between the two pieces of tissue were definitely not composed of elongated fibrocytes and cardiac muscle cells (see Fig. 1).

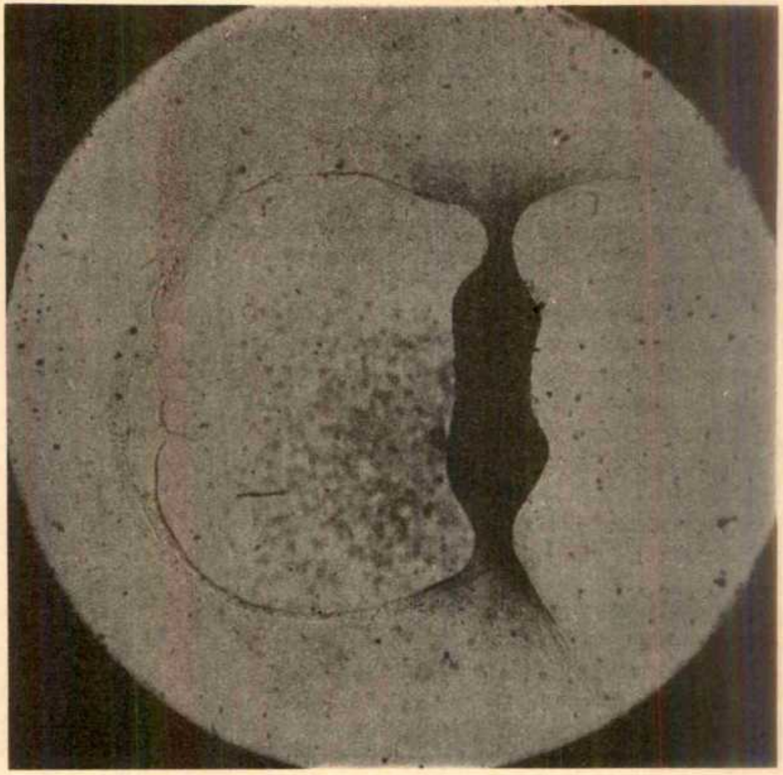


Fig. 2.

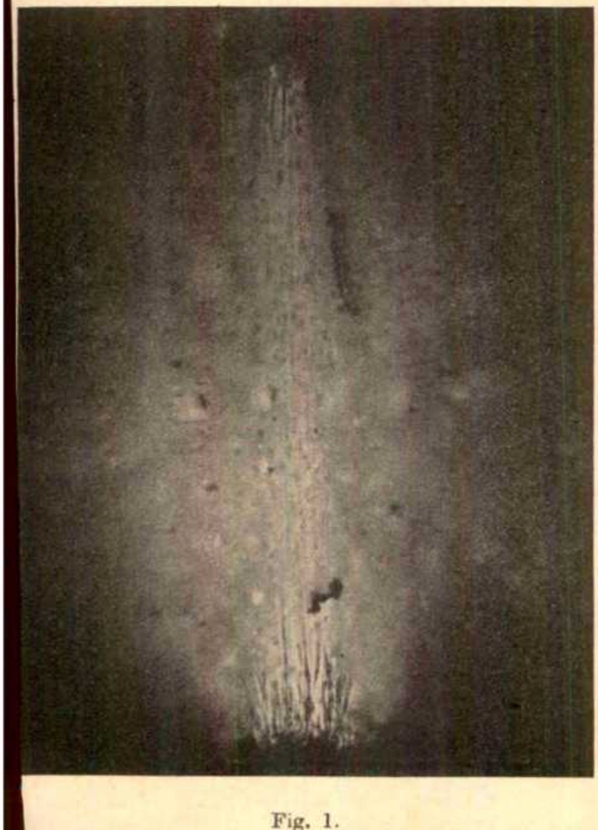


Fig. 1.

A related phenomenon of interest (in some respects similar to the outgrowth obtained with the intestine cultures) was the nature of the subsequent growth pattern within the attraction field. It is well known that isolated fragments of tissue *in vitro* usually exhibit a zone of new growth and migration in a radial fashion, that is, the cells appear to have come from the central portion of the tissue explant and continue thus into the plasma medium; however, in such cases where an attraction field was in evidence between two fragments of tissue in the plasma clot, the uniform radial growth was slightly but decidedly altered. That portion of the outgrowth which lies within the field, or from which the field seems to emanate, does not form a sector of radial growth, but is rather a bundle of elongated cells following the parallel 'lines of force'. As the cultures grow older, fibrocytes proceed from both fragments until the gap within the field is completely filled with the elongated cells.

These attraction fields have also been observed between pieces of embryo skin and liver. The fields have never been detected between a dead and a living tissue.

Though the fields were not nearly as evident nor as numerous, mouse embryo heart explanted in the same medium with chick embryo heart gave indications of a very weak field of attraction.

Though a sufficient number of cultures have not yet been prepared from which to draw conclusions, attraction fields between pieces of adult tissue have not been found.

A total of about 1,500 cultures have been prepared, and among these some 150 definite fields have been observed (Fig. 2. 113-hr. culture, 19-day chick embryo intestine. Plasma Drew).

Whether the attraction fields observed by the authors bear any relation to the plasma fibrin strands produced by Doljanski and Roulet[2] is not yet known. The experimental procedure employed by the latter investigators is quite different from our own in so far that they applied tension to plasma membranes and found cellular growths of explanted tissue oriented parallel to the fibrin strands. In our experiments, tension was not purposely applied to the plasma clot. We feel justified (for the present, at least) in ruling out any tension phenomena in the plasma clot being responsible for the observed fields. If it were a matter of tension, then it would seem reasonable to assume evidence for such in the cultures containing a dead and a living fragment of tissue. This was not found to be the case.

Further investigations are being continued in an effort to discover the true nature of these *in vitro* fields.

JOHN C. FARDON.
GUSTAVE BROTZGE.
SISTER M. KENNETH LOEFFLER, O.P.
JUANITA BREIT.

Institutum Divi Thomæ,
Cincinnati,
Ohio.
Sept. 20.

---

[1] Fardon, J. C., Sullivan, W. A., and Andrus, Sr. M. Basilia, *Studies Inst. Divi Thomæ*, vol. 2, No. 2, 233 (1939).

[2] Doljanski, L., and Roulet, Fr., *Roux's Arch. Entwicklungsmech. Organ.*, **131**, 3, 512–531 (1934).

Occurrence of Xylans in Marine Algæ

WHEN the red alga, *Rhodymenia palmata*, commonly known as 'dilisk' or 'dulse', was immersed in dilute hydrochloric acid for about twenty-four hours, a viscid solution was obtained and, when this solution was poured into alcohol, a white solid was precipitated from it. This substance swelled up and dissolved when put into water. After purification by three precipitations with alcohol, the opalescent solution was cleared by repeated filtration. The substance now had a specific rotation of about −87. On hydrolysis with dilute nitric acid, it yielded crystalline xylose.

This appears to be the first record of the isolation of a xylan from a marine alga, although, about seven years ago, Schmidt-Neilsen and Hammer[1] noted the high yield of furfural obtainable from *Rhodymenia palmata* and estimated the pentosan content of the plant.

Another red alga, *Dilsea edulis*, also gives a highly viscid solution on treatment with dilute hydrochloric acid; but the substance obtained from this by precipitation with alcohol was not hydrolysed to xylose. This substance appears to be an ethereal sulphate similar to those already found in other marine algæ. It yields mucic acid on oxidation with nitric acid.

These substances are being further examined and the results of the investigations will be published elsewhere.

VINCENT C. BARRY.
THOMAS DILLON.

Chemical Laboratory,
University College,
Galway.
Oct. 19.

---

[1] *Chem. Abs.*, **27**, 5097 (1933).

Average Gestation Period and $n\pi$

IN a number of instances, average gestation periods seem to differ by a few hours only from $n\pi$ days. A few of the more remarkable approximations are :

n	$n\pi$	Average gestation period (days)	No. of pregnancies	Animal
10	31·416	31·41	64	English rabbit[1]
36	113·097	113·1 ± 0·12	203	Pig[2]
48	150·796	150·8 ± 0·13	195	Karakul sheep[3]
		150·8 ± 0·19	391	Black Forest goat[4]
49	153·938	154	?	Saanen goat[5]
92	289·026	288·9	428	Simmental cow[6]

Further data are being studied.

J. H. KENNETH.

University Union,
Edinburgh.
Oct. 10.

---

[1] Rosahn, P. D., *et al.*, *Science*, **79**, 526 (1934).

[2] Husby, M., *Meld. Norges Landbrukshøiskole* (1933).

[3] Baranov, A. G., *Usp. zootech. Nauk*, **5** (1937).

[4] Hinterthür, E., *Züchtungskunde*, **8** (1933).

[5] Kiesling, A., *Z. Züchtg.*, **27** (1933).

[6] Indermühle, *Schweiz. Arch. Tierheilk.* (1911).

Psychology and Camouflage

PERUSAL of the interesting article by "J. S. H." on camouflage in NATURE of October 12 leaves one rather wondering why the technical staff of the organization described should include artists, engineers, architects, chemists, physicists, photographers, and a botanist, while apparently not a single psychologist is connected with this organization. Surely the problems of camouflage are problems in perception, perhaps the most advanced field of psychological study. The fundamental laws on which camouflage must be based are partly psychological (the Liebmann law, for example, which deals with the relative differentiation due to colour and brightness, or the Wertheimer laws of organization), and it seems reasonable to ask why no use is being made of the vast amount of knowledge available.

H. J. EYSENCK.

28 Howitt Close,
Howitt Road,
London, N.W.3.
Oct. 14.

RESEARCH ITEMS

Prehistoric Trepanning in Europe

In connexion with the record of a trepanned skull of the Beaker Period found in a group of round barrows at Crichell Down, Dorset, in 1938, Stuart Piggott discusses the distribution of the practice of trepanning in prehistoric Europe (*Proc. Prehist. Soc.*, N.S., 6, 1; 1940). The recorded examples show a surprising range extending from Portugal to Sweden and in time from Danubian I to the Scandinavian Iron Age (3000 B.C.–200 B.C.). The great majority, however, are concentrated within a fairly restricted area and period. In the Cevennes, a date round about 1900–1500 B.C. seems likely for the main period. This undated group of megalith builders appears to have affected profoundly the neolithic peasantry of the Paris basin. With the cult of the guardian goddess of the megalith builders of the south also came the cult of ritual trepanning, the deliberate making of holes in the skull of the living for some now obscure purpose of magic or witchcraft. Another related scalp operation was the culling of the sincipital T. With the spread of the SOM culture of the Paris basin the practice of trepanation was also introduced to other regions. The primary reason for the practice was no doubt the alleviation of pain by surgical mean. In this category may be placed the early Danubian cases, those from Scandinavian dolmens, chalcolithic skulls from Portugal and the earlier examples from the Cevennes—all possibly the result of independent invention. When, however, the practice becomes a cult it is legitimate to look for links connecting centres of concentration. Hence the cult may be traced from the Cevennes to the Seine, thence to Sweden and probably to Germany, the intensity of the cult waning in direct ratio to the distance from the diffusion point. In Czechoslovakia the group may owe its origin directly to the beaker people. The English examples are at first sight difficult to fit into a Continental series as a whole. If it may be argued legitimately that the supposedly earliest example of ritual treatment, the Maiden Castle skull, is contemporary with the skull from Crichell, both though in different contexts may be regarded as of Beaker Age as also may the Bisley skull, though derivative from a long barrow, possibly as a secondary interment. The Ovingdean specimen, however, does suggest SOM examples, and having been dredged up may be derived from across the Channel.

Toxicity of Alpha and Fast Neutron Radiation

Robley D. Evans, of the Massachusetts Institute of Technology, described the results of experiments on neutron tolerance in animals in a paper at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. He finds that the results cannot be accurately extrapolated to man because the relative radiation sensitivities are entirely unknown for small doses. Biological effects of neutrons are due to the secondary recoil rays which they produce in the body by collision with hydrogen, carbon, nitrogen, oxygen, and other atoms. The average specific ionization, and hence the ionic effectiveness, of the neutron recoil rays is closer to that of alpha rays than to any other radiation which has been the subject of extensive biological investigations. Data are available from studies of chronic radium poisoning, and of lung cancer produced by radon inhalation, concerning the effects of alpha rays on human tissue. Using these data, it is shown that a dosage of 0·01 r. per day of fast neutrons may be unsafe if the exposure continues over a period of about ten years.

Differential Periodic Theory of Growth

G. F. Sleggs (*Growth*, 4, 1) derives the high synthetic power of protoplasm from a strained chemical cagework of genar lattices in rotational stagger. An explanation of a number of biological properties is offered in terms of the geometrical relationships arising in such a system; to those dealt with in an earlier paper are added persistence of cell bridges, division of spireme into chromosomes and the disturbance of pigmentation pattern upon salient surfaces. The extension of the staggered genar lattices produces an epigenetic pattern upon the hitherto maintained impossible basis of corpuscular preformation. The author considers that adaptation is an inherent property of the system, on the basis that rotational shift of genes brings morphogenetic gradient components into associations which determine equilibrium patterns; this shift is produced by the environment. The origin of the organism is attributed to the chemical union of lattices via an intermediate framework of amino-acid residues in such a way that the spacing of units does not correspond, producing a differentiated system with equipotential properties of regeneration and regulation.

Photosynthesis and Fluorescence

The rapid method of measuring rates of photosynthesis developed by Dr. McAlister has recently been used in a preliminary survey of the relation between photosynthesis and fluorescene during induction periods by E. D. McAlister and J. Myers (*Smithsonian Misc. Coll.*, 99, No. 6; 1940). Wheat (var. Marquis) and *Chlorella pyrenoidosa* were used as experimental material. It was found that any sudden changes (in, for example, light intensity, carbon dioxide concentration) producing large increases in the photosynthetic rate cause a 'burst' of fluorescence. When the change is from darkness to high light this burst can be resolved into three parts: (1) the intensity of fluorescence rises to a value about equal to that of final equilibrium ($<$ 0·01 seconds); (2) a further slow rise (1 second) follows, to a position two or three times higher; (3) fluorescence decays from this maximum to the equilibrium value (1 minute). The simultaneously recorded rate of carbon dioxide assimilation follows a curve inversely related to this. At low oxygen pressures, the curves of fluorescence and rate of carbon dioxide uptake are in fact almost exact mirror images (as to time). In both wheat and Chlorella it appears that the changes in carbon dioxide assimilation during the induction period under normal air conditions are, however, caused by two processes, one inversely (as above) and one directly related to intensity of fluorescence. The dependence of this second type on oxygen pressure, and the observation of greater carbon dioxide uptake under low oxygen pressures, suggest that this second type of reaction is a photo-oxidation. In Chlorella acclimatized to low carbon dioxide, the photo-oxidation type of reaction predominates. Under steady state conditions following the induction periods, a marked change in fluorescence occurs on passing from light-limiting to carbon dioxide – limiting conditions. The rate of carbon dioxide assimilation in wheat in high light and 0·03 per cent carbon dioxide is 30–50 per cent higher in 0·5 per cent than in 20 per cent oxygen. This suggests that in young wheat a reaction of large proportion opposing photosynthesis is always active under natural growing conditions.

Smut Resistance and Interchanges in Maize

C. R. Burnham and J. L. Cartledge (*J. Amer. Agron.*, **31**, 924–933; 1939) utilize lines carrying reciprocal translocations to discover the loci of genes for susceptibility of maize to smut. Each line was crossed to a resistant line and the F_1 backcrossed to a susceptible line. Linkages were observed between smut resistance and the interchanges $T_{1\text{-}2c}$, $T_{1\text{-}6a}$, $T_{1\text{-}9c}$, $T_{2\text{-}6a}$, $T_{3\text{-}8a}$, and $T_{6\text{-}8a}$, and probable linkages with other translocations. It is probable that the locus of the translocation breaks in chromosome 2 involved in $T_{1\text{-}2c}$ is linked with smut resistance and that in the remaining cases the break-loci of one or both chromosomes is linked with smut resistance. The procedure to be adopted for analysis by means of reciprocal translocations is outlined.

Polyploids in Cotton

S. C. Harland (*Trop. Agric.*, **17**, 53–54; 1940) has doubled the chromosome number of various cotton species and their hybrids by the use of colchicine. He shows that octoploids have an increased cell size as compared with the tetraploids, but the hairs, while larger, are too weak for economic purposes. On the other hand, synthesis of allotetraploids which will cross with the forms of *G. barbadense* and *G. hirsutumn* will be useful. Since *G. Thurberi* carries immunity to Pink boll worm, the allotetraploid *Thurberi* × *arboreum* is of great economic advantage. Similarly hexaploids raised from the hybrids *barbadense* × *aridum*, *barbadense* × *Thurberi*, and *barbadense* × *Armourianum* give promise of resistance to drought, diseases and insects.

Tertiary Volcanic Rocks of Victoria

A. B. Edwards and W. Crawford have made a valuable field and petrological study of the volcanic rocks which cap the Gisborne Highlands in Victoria (*Proc. Roy. Soc. Victoria*, **52**, 281–311; 1940). The volcanic complex of Mount Gisborne is built up of a series of hypersthene-trachyandesites and hypersthene-bearing basalts in addition to a variety of normal types. The trachyandesites and associated rocks contain more or less resorbed phenocrysts of felspars and hypersthene and also numerous xenocrysts of quartz, presumably derived from the sediments through which the magma had passed. These lavas present the apparent anomaly of a 'tholeiitic process of differentiation' superimposed on the normal (trachytic) process. It is suggested that this local change in the character of the differentiation was brought about by local assimilation of sediments, whereby the parental basaltic magma became saturated with respect to silica. A similar hypothesis has already been proposed to account for the trachyandesites of the Coliban district of Victoria (*Q. J. Geol. Soc.*, **94**, 243–320; 1938). Effective comparison of the suite of volcanic rocks under discussion is made with similar suites from the Circum-Japan Sea Province, Kerguelen Island and Ascension Island.

The Imperial Valley (California) Earthquake

The Imperial Valley earthquake of May 18, 1940, has been classed as fifth in the list of destructive earthquakes in the history of America (*Earthquake Notes*, **22**, Nos. 1 and 2, September 1940). Its direct cost has been estimated at some five or six million dollars, as compared with about twenty-five million dollars for the great San Francisco earthquake of 1906. The epicentre of the recent shock was near Brawley, where considerable destruction was done to parts of the water and sewer systems, though more buildings were damaged at Imperial. Well-constructed steel and reinforced concrete buildings did not suffer so much as the poorly constructed buildings and those made of adobe. An intensity X was reached on the modified Mercalli scale (some well-built structures destroyed, ground badly cracked, rails bent, landslides, etc.). Roads and bridges were damaged and one bridge had to be closed. Direct loss of life was only nine though scores were injured, and the shock was felt over an area of 60,000 square miles. The strong-motion instrumental record at El Centro, California, indicated that the horizontal acceleration of the ground during the earthquake was approximately one third that of gravity at El Centro, though the record is incomplete as the spot of light was thrown off the paper at both sides. At one point in the area the permanent horizontal ground displacement was about 12 ft., and a vertical displacement of 3 ft. has been found. In general, where slippages occurred at the surface, the movement was north-west for the west side of the fault, a condition that generally occurs in Californian earthquakes. A surface fault apparent after the shock could be traced in an almost straight line for more than 40 miles. More than thirty-five aftershocks were felt at intervals over a period of more than a week.

Precipitation of Colloids by Electrolytes

It is known that the concentration of electrolytes required to coagulate hydrophobic sols varies with the sol concentration. Burton and Bishop suggested that the precipitating values of univalent, bivalent and tervalent ions increase with, are independent of, and decrease with the sol concentration, respectively. Ostwald introduced the rule that the activity coefficients of various precipitating ions are constant at their precipitation values. H. B. Weiser and W. O. Milligan (*J. Amer. Chem. Soc.*, **62**, 1924; 1940) in an investigation of relatively pure sols of copper ferrocyanide, ferric oxide and arsenic trisulphide have shown that neither rule has any general validity. The slope of the precipitation value – sol concentration curve depends upon the adsorbability of the precipitating ions, the stabilizing effect of the adsorption of ions of the same sign of charge as the sol, and the purity of the sol. Burton and Bishop's rule may be restated in the form that for a given sol the *proportionate* increase in stability towards precipitating electrolytes or dilution is in general greater for electrolytes with univalent precipitating ions than for electrolytes with multivalent precipitating ions, and is greater the higher the purity of the original sol. Ostwald's rule did not apply to the observations at any concentration of sol.

PRACTICAL ASPECTS OF EARTHING

In the October issue of the *Journal of the Institution of Electrical Engineers* the important joint paper compiled by E. Fawssett, H. W. Grimmitt, G. F. Shotter and Dr. H. G. Taylor, on practical aspects of earthing, is published in full, together with the relevant discussion of the Transmission Section.

Particular attention is given to the methods of earthing the networks of supply stations so as to prevent dangerous high potentials occurring at any point. According to the definition given in the Electricity Supply Regulations, "connected with earth" means connected with the general mass of earth in such a manner as will ensure at all times an immediate and safe discharge of energy. The authors say that it is sometimes found that it is difficult to make a connexion with the general mass of earth in such a way as will ensure at all times a safe discharge of energy, depending as it does on the conductivity of the soil and the position of lakes, rivers, etc., in the neighbourhood.

In the discussion, Mr. J. F. Shipley appreciates the authors' suggestion that engineers should use geological drift maps, but points out that they have to be used with care as they are always made on a very large scale. With regard to the subject of rainfall, he said that in Great Britain it is very satisfactory from the point of view of earthing; there is plenty of it all the year round but not too much. Mr. Shipley has had experience of countries where the annual local rainfall is 400 inches and it nearly all falls within two or three months; the rain is so heavy that it sometimes completely washes the earth connexion away. The rain water is itself of very low conductivity, and as it falls in such quantity it acts as a leaching agent and washes all the conducting salts out of the soil, so that although the soil is soaked with the water in the wet season, it is still a bad conductor.

Figures are quoted bearing on this point. The condensate in a modern turbo-generating station has a conductivity figure (the reciprocal of megohms per cm. cube) of about 2. London rain water has a conductivity figure of about 390, and Glasgow water of about 120. Manchester water, one of the softest on record, has a conductivity figure of 48, and sea water a figure of 50,000. In one case Mr. Shipley found the conductivity of the water to be of the order 18; this was after six months storage in a reservoir and a five or six mile journey along a river bed. He estimates that the original conductivity figure was about 10. When, therefore, heavy rainfall occurs in atmospheres that are comparatively free from dust and pollution, the rain water is an almost perfect insulating material. He found this out in a practical way by trying to test a 6·6 kv. alternator on a testing tank. Ordinary water from the hillside was used, and it was found that with electrodes in water three feet apart there was not the slightest sign of current passing between them.

A case was also described where considerable damage was done by lightning to a lead-covered cable in the dry climate of South Africa. The cores were repeatedly damaged by discharges within the cable which coincided with lightning strokes striking the ground some distance away. In Great Britain we are accustomed to think that if lead-sheathed cable is buried in the earth, the conductor inside is safe from external discharges, but this incident shows that this is not the case. Owing to the dryness and high resistivity of the soil, the earthing secured by the cable being buried was insufficient; and the cable is now being additionally earthed at intervals by pipe-earths.

Mr. P. B. Frost pointed out that telephone cables are damaged by lightning in Great Britain as well as in Africa. In one case, a long main underground cable not connected in any way with overhead lines developed about ten faults distributed over some miles, due to lightning discharge between the sheath and the conductors.

THE ACOUSTIC AIR-JET GENERATOR

In 1916, Prof. Hartmann, of Copenhagen, while exploring with a Pitot tube the distribution of total head in a high-speed jet of air, observed that the pressure along the axis of the jet underwent a cyclic variation with its distance from the discharge nozzle. This so-called Pitot curve, shaped like a sine wave of diminishing amplitude, comprises successive wave-lengths along which the pressure is alternately falling and rising. It was found that the intervals of rising pressure were unstable. When, for example, the pressure over these regions was explored with a wide Pitot tube, unstable readings were obtained, indicating that the air in the jet alternately entered and was discharged from the tube with a regular frequency. The same phenomena occurred when the open end of a hollow vessel or oscillator' was mounted in a rising pressure of the air jet, the result with this arrangement being the production of vigorous sound waves varying in frequency according with the volume of the oscillator and the size of its open end.

In *Engineering* of October 18, it is stated that Prof. Hartmann has spent several years in developing an acoustic sound generator based on this principle. In his researches he has been assisted by three other physicists and supported financially by Danish endowments. The generator was described and demonstrated by Prof. Hartmann at the Blackpool meeting in 1936 of the British Association.

The final account of Prof. Hartmann's work, now issued in English as No. 4 of the Ingeniorvidenskabelige Skrifter (Akademiet for de Tekniske Videnskaber ok Dansk Ingeniörforening), covers a good deal of experimental research hitherto unpublished in English, and presents complete data and theoretical analyses immediately useful to research workers in acoustics.

It appears that the fundamentally scientific aspects of the generator and its mode of operation have been adequately covered. Except for its obvious utility as a source of controllable sound for acoustic research, the authors in this paper put forward no specific suggestions for applying it usefully in engineering or other industries, although in previous accounts they have discussed its possibilities for precipitating smoke and dust in the atmosphere and for producing supersonic vibrations which might be employed for testing the quality of materials. Its potentialities as a means of communication and for transmitting supersonic energy through the air will also warrant the closest consideration. But over the audible range of frequency the Hartmann generator is faced with the opposition of a host of already firmly established competitors. The article concludes by saying that the reticence of the inventors on new ways and means of augmenting the sufferings of a noise-tormented world has much to commend it.

FEMALE SEX HORMONES*

The Ovarian Follicular Hormones

By Prof. E. A. Doisy, St. Louis University

The ovarian follicular hormone, manufactured in the ripening follicle of the ovary, is one of the so-called œstrogenic hormones—chemicals which cause the female to exhibit mating behaviour. In the human and in other animals the œstrogenic hormones prepare the lining of the uterus for the reception of the fertilized egg, stimulate the development of mammary glands, and at the time of birth activate the womb.

Of more practical interest, however, are the remarkable therapeutic benefits obtained with these hormones in a variety of conditions. Some of the most striking results have been achieved in ameliorating the effects of the menopause and in correcting various disorders associated with the sex cycle.

Doisy and associates were the first to isolate an œstrogenic hormone in crystalline form in 1929. The substance, which was called theelin, was extracted from human urine. Later it was isolated from numerous other sources.

While theelin is produced in the ovaries and, during pregnancy, in the placenta, the hormone is much more easily extracted from the urine. The first yield from this source was only 1·5 mgm. It was not until 1935 that Doisy, MacCorquodale and Thayer were able to extract the œstrogenic hormone from the organs themselves, and in this work they used four tons of ovaries from sows. It took two years to obtain enough of the pure compound for thorough chemical and biological characterization, for the concentration existing in the swine ovary was only 6 mgm. per ton, or about one part in 150,000,000. The pure material was named α-dihydrotheelin, differing from theelin only in the addition of two more hydrogen atoms. In obtaining the substance from human material, one worker used 702 full term placentas, which were obtained at childbirth and which weighed altogether a half ton.

Prof. Carl Bachman synthesized theelin in 1940 from simple organic compounds, an achievement which may be described as one of the outstanding accomplishments in the sex hormone field. This and other œstrogenic hormones prepared synthetically are so much cheaper than the products obtained by necessarily tedius extraction of the natural material that the therapeutic use of the compounds is increasing.

Toxic effects are, however, reported by some physicians using synthetic hormones, and it is to be hoped that chemists may be able to remove the toxicity without producing loss of the œstrogenic property.

The Gonadotropic Hormones

By Prof. P. E. Smith, Columbia University

Intensive study of the interaction between these particular members of the endocrine system, namely, the pituitary and the sex glands, began about thirteen years ago, when it was discovered that the sex glands were not independently functioning organs but were dependent upon some unknown but essential X-substance for their maintenance. It was next revealed that this X-substance which stimulated the sex glands was supplied by the anterior lobe of the pituitary gland (also known as the anterior hypophysis).

In rapid succession three rich sources of gonad-stimulating (gonadotropic) substances were found. One was the urine of pregnant women. One was the urine of women who had had their ovaries removed or who had passed the menopause. The third was the blood serum of pregnant mares. The effects of these substances were observed not only by clinical use in various disturbances of the normal cyclical behaviour of the female sex glands but also in laboratory tests upon animals—principally rats and monkeys—the pituitary glands of which had been removed.

One of the early complications in this study was the fact that all species do not react identically or even similarly. Also extracts of pituitary glands from various species of animals gave different responses on one species of test animal. These differences early gave rise to the concept that the somewhat different effects were due to the presence of more than one gonadotropic hormone in the pituitary.

In 1931, Dr. Frederick L. Hisaw and Dr. H. L. Fevold, of Harvard, announced they had obtained two gonadotropic fractions from the pituitary gland of the sheep. One they called the *FSH* (follicle stimulating hormone) and the other became known as the *LH* (luteinizing hormone). According to their theory, which was supported by several other workers, the *FSH* causes growth of the follicle in the ovary. The œstrogenic hormone of the follicle in turn influences the pituitary and causes secretion of the *LH*. When the two pituitary hormones are in proper balance, ovulation occurs and then the *LH* causes formation of the corpus luteum, the yellow body which fills up the place formerly occupied by the ovum before it was extruded by the erupting follicle.

---

* Substance of a symposium held at the Bicentennial Conference of the University of Pennsylvania on September 18.

A number of recent researches have cast doubt on the existence of these two separate gonadotropic hormones of the pituitary, and suggest that the different types of response in the test animals may be due to the differing rate of absorption of the hormone.

The maintenance of the gonads is complicated even if it is effected only by a single gonadotropic hormone and if only one sex and one species of animal is considered. If it is due to two hormones the situation becomes very much more complex. Although some thirteen years have elapsed since the subject began to be intensively studied, nevertheless it appears that little more than a start has been made in securing an understanding of the many factors involved.

EXACT SCIENCE IN ANTIQUITY*

CONTACT between highly different cultures apparently gave the impetus to important developments in the early history of the exact sciences, namely, mathematics and astronomy. The development of exact science cannot be adequately described as a systematic step-by-step progress. In any event where we are able to disclose the conditions of essential new development, the contact between highly different cultures appears to give the initial impetus. On the other hand, 'culture' is in itself equivalent to tradition, which unifies large groups of populations into a common type of opinion and action. However, the same force, tradition, which defines a culture as an individual being, becomes an increasing impediment to further independent development and creates the long periods of 'dark ages', which cover by far the largest part of human history.

The mathematical texts of the First Babylonian Dynasty, that of King Hammurabi (about 1800 B.C.) treated elementary geometrical problems in a very algebraic form. This rise of the abstract representation in mathematics may be attributed to a historical event, the complete replacement of the Sumerians by the Semitic population.

The Semites, coming into the land of the Sumerians, began to write their own Semitic language with the Sumerian picture script. The Sumerians used a single sign for a single concept (ideograms). The Semites took the signs and used them in two different ways: first, in their old sense as representations of single concepts, and secondly, as pure sound symbols (syllables) for composing their own words phonetically.

Using the symbol to represent a single concept corresponds in the field of mathematics exactly to our algebraic notations. Instead of writing 'length' with six letters, for example, it was sufficient to write a single letter 'L', or instead of writing out 'plus' or 'addition', it was sufficient to use one single sign +.

Evidently the idea of this algebraic form of mathematics occurred to the Semites when they saw the single symbol or ideogram form of writing alongside their own phonetic system. We see here again how an entirely unconscious external influence caused the second fundamental invention of 'Babylonian mathematics', the 'algebraic' notation. Without such a deep linguistic difference such a powerful instrument as ideographic notation for mathematical operations would never have been introduced, as the parallel with Egypt clearly shows.

An atmosphere of general learning conducive to improvement along many lines of scholarship and science was created by the necessity of translating the language of the original occupants of this section of Mesopotamia to that of the new rulers. Systematic philological schools were created, and their existence is recorded by the large collections of word lists, grammatical rules, etc., used in the translation of Sumerian to Semitic.

Later in the history of Babylon, when it was conquered by the Assyrians, who constructed a powerful kingdom reaching from Persia to Egypt, politically powerless Babylon became an admired cultural centre of a world-wide empire, comparable to the position of Rome in medieval times. Persian priests, Jews, and Greeks lived in Babylon, and used Aramaic as an international language. There arose competition between the national cultures, for example, Zarathustra, Abraham and Pythagoras were each proclaimed as the inventor of all science and creator of astronomy, astrology, and number-wisdom, and each group asserted itself to be the oldest and consequently the teacher of mankind. This atmosphere of intellectual competition stimulated further development of Babylonian astronomy. This new astronomy was based not on old observation of miraculous exactitude, as usually pretended, but, on the contrary it reduced the empirical dates to the utmost minimum, mainly period relations, which are easy to observe and almost unaffected by the inexactitude of single instrumental observations.

Ptolemy (100–180 B.C.) was one of the greatest scholars of all times. High tribute should be paid to the supreme mastership and independent judgment exhibited in Ptolemy's "Almagest" on mathematical astronomy, his "Tetrabiblos" on astrology, and his "Geography".

The main school of geographers, however, did not follow Ptolemy, but preferred general descriptions of different regions and their population to the more fundamental problem of exact mapping, which involved astronomical observations for determination of geographical position. This tendency toward popular representation was one of the main reasons for the rapid decline of ancient exact science, and it finally created the race of commentators, who killed any kind of independent thinking with their tedious explanations of every little step.

The sexagesimal system of the Sumerians, in which the unit represented powers of 60, such as 60 itself, 3,600 or 1/60 is worthy of note. (We have a remnant or suggestion of the sexagesimal system in our clock dial of 60 seconds to the minute and 60 minutes to the hour.)

The Sumerians at first represented the units of different powers to 60 by a difference in size of the symbol, but later this careful notation was omitted, and 'place value' notation was initiated, the ancestor of our present decimal number system.

---

* Substance of a paper read by Dr. Otto Neugebauer at the Bicentennial Conference of the University of Pennsylvania on September 17.

WORK OF THE IMPERIAL INSTITUTE

By Sir Harry Lindsay, K.C.I.E., C.B.E.,

Director, Imperial Institute

Dr. COLLINGE'S account, published in Nature of October 19, p. 526, of the work of the Philadelphia Museum shows that it follows lines closely analogous to those adopted by the Imperial Institute in the display of raw materials (in our case, of the British Empire) and the 'story' of their transformation to finished goods. The Institute is also a bureau of technical information based not only on investigations carried out in our own laboratories but also on information available from technical and trade journals in all languages.

Unfortunately, our exhibition galleries and cinema have had to be closed under war conditions. We still continue, however, to send films of the Empire on loan to schools and societies throughout the United Kingdom. In place of our series of lectures on the overseas Empire, which used to attract many hundreds of school parties to our cinema, we have adopted a scheme whereby a panel of Empire lecturers is made available to primary and secondary schools in reception areas. Our latest development is to try to transfer, with the help of our artists, the 'story' of the transformation of raw materials into finished commodities from showcases in our galleries to posters which will be made available to schools together with lecture notes to accompany them.

With regard to our technical intelligence bureau, the Institute's staff includes tropical agriculturists, chemists, chemical technologists, economic botanists, economic geologists, mining engineers, mineralogists and statisticians, all of whom are expert in their particular subjects. When desirable, the Institute seeks the advice of members of its fifteen consultative committees, which comprise authoritative professional and business men. Further help is also afforded by numerous trade contacts.

The Institute also has an extensive reference library and a technical index covering most of the relevant trade and scientific publications issued during the past thirty years.

Examples of the type of inquiry dealt with at the Institute include the following: Inquiries relating to sources of supply of raw materials and semi-manufactured products whether of animal, vegetable or mineral origin in all countries; inquiries relating to the marketing of overseas products; detailed statistics of production, consumption and trade in all countries; questions concerning the normal uses of all raw materials and most semi-manufactured products and discussions concerning possible new or alternative uses; inquiries concerning the specifications as to qualities and types of raw materials necessary for various purposes; questions arising out of a desire to substitute one commodity for another; details of the methods employed in the cultivation of crops and the soil and conditions under which they have to be grown; details of the methods employed in mining, smelting and dressing minerals for the market; methods of processing and preparation for the market of animal and vegetable products, and particulars of machinery and equipment used for these purposes; details of the location and plant capacity of works at which smelting or refining or other processing is carried out; analysis and testing of samples of raw materials in the laboratories of the Institute.

FORTHCOMING EVENTS

Monday, November 11

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. Dudley Stamp: "Productivity and Classification of Land in Britain".

Wednesday, November 13

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. K. G. Fenelon: "Some Problems of Wartime Labour Management."

Thursday, November 14

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Prof. A. Fleming: "Antiseptics in Wartime Surgery".

Friday, November 15

North-East Coast Institution of Engineers and Shipbuilders (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Dr. G. S. Baker: "Vibration Patterns of Propeller Blades".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Two Graduates in Engineering at the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (November 13).

Head of the Electrical Engineering Department at the Chesterfield Technical College—The Clerk to the Governors, Technical College, Infirmary Road, Chesterfield (November 16).

Headmaster of the Shipley Art School and Headmaster of the Shipley Technical Institute (combined appointment)—The Secretary to the Managers, West Riding County Council, Town Hall, Shipley (November 20).

Trained Graduate Assistant Master to take Chemistry, and Assistant Master for Engineering Subjects—The Head Master, The Modern School, Cole Street, Scunthorpe, Lincs.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

East African Agricultural Research Station, Amani. Annual Report, 1939. (Colonial No. 180.) Pp. 26. (London: H.M. Stationery Office.) 6*d*. net. [2210

Wool Industries Research Association. Animal Fibres of Industrial Importance: their Origin and Identification. By A. B. Wildman. Pp. 28+23 plates. (Leeds: Wool Industries Research Association.) [2310

Other Countries

Indian Forest Records (New Series). Silviculture, Vol. 3, No. 8: A Note on the Artificial Regeneration of the Dry Fuel Forests of the Madras Province. By A. L. Griffith. Pp. vii+291–322. (Delhi: Manager of Publications) 1.14 rupees; 2*s*. 9*d*. [1410

Indian Association for the Cultivation of Science. Annual Report for the Year 1939. Pp. 44. (Calcutta: Indian Association for the Cultivation of Science.) [1410

U.S. Department of Agriculture. Miscellaneous Publication No. 354: A Review of the Parasitic Wasps of the Ichneumonid Genus *Exenterus* Hartig. By R. A. Cushman. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents. [1510

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 13: Four Hundred Word Chin Tan of Chang Po-Tuan; Three Alchemical Poems by Chang Po-Tuan; Shih Hsing-Lin, Disciple of Chang Po-Tuan and Hsieh Tao-Kuang, Disciple of Shih Hsing-Lin; The Secret Papers in the Jade Box of Ch'ing-Hua, and A Fifteenth Century Chinese Encyclopedia of Alchemy. By Tenney L. Davis and Chao Yun-ts'ung. Pp. 371–400. 1 dollar. Vol. 73, No. 14: Gyromagnetic Ratios for Ferromagnetic Substances; New Determinations and a New Discussion of Earlier Determinations. By S. J. Barnett. Pp. 401–456. 1.75 dollars. (Boston: American Academy of Arts and Sciences.) [1510

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Talc, Steatite and Soapstone: Pyrophyllite. By Hugh S. Spence. (No. 803.) Pp. vii+146+8 plates. (Ottawa: King's Printer.) 50 cents. [1510

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 16, 1940 No. 3707

WELFARE OF YOUTH

ONE of the most remarkable developments that the War has brought has been the concentration of interest on the so-called youth movement. This has been due in large measure to the increasing attention that is being devoted to the question of maintaining good standards of health during the periods of early and late adolescence in order that the valuable work performed by the school medical services might not be undone before maturity is attained. The transitional period marking a young person's introduction to industrial life is properly regarded as being critical from the health point of view, and every attempt at improving those facilities which promote the cultivation of positive attitudes towards health and conduct is bound to receive sympathetic consideration as an effective means in the building of character. Unfortunately, many individuals who bear the responsibility for safeguarding the interests of youth, and particularly some who have voluntarily undertaken work in the various youth organizations, have become extremely suspicious that the attention which is being given to the fourteen to twenty age-group has been artificially engendered with the sole object of providing recruits of a better standard of fitness for the armed forces, and that the continuance of the interest is unlikely to survive when the peace comes (see p. 647 of this issue). This must never be; the object of any youth movement must be to produce citizens worthy in mind and body of a worthy heritage.

Yet the circulars, "The Service of Youth" and "The Challenge of Youth", issued by the Board of Education during the past year, have, in a few cases, served to strengthen this suspicion because of the emphasis given in them to physical education. Where the circulars have been read in the spirit with which they were written, however, all doubts on this point are readily dispersed. The Board of Education must be credited with having made a genuine attempt to point the way towards the development of a youth movement which should not only become well established during the War, but would also form a highly significant and invaluable means of reconstruction in the peace which is to come.

A more widely held suspicion on the part of youth leaders relates to the steps which the Board of Education has taken in order to encourage interest in questions pertaining to youth. The setting-up of the National Youth Committee soon after the outbreak of War was greeted with acclamation by the many but with very real apprehension by a vociferous minority. The latter regarded this pronouncement as but the first of a series which would lead eventually to what they imagined would be the compulsory regimentation of youth and gradually to the superceding of all voluntary activity and initiative. In no way does one wish to subscribe to this point of view, but it must be said that the situation has been allowed to continue in such an atmosphere of doubt and uncertainty that the National Youth Committee has, by its own unbroken reticence, contributed in great part to the present state of confusion. The position needs immediate clarification if the services of many of the already active youth leaders are to be retained, and if, as is so urgently required, we are to see the extension of the youth programme according to a national policy.

The function of the National Youth Committee appears to have been as carefully concealed as has been its constitutional powers and terms of reference. From time to time statements from individual members of the Committee appear in the educational Press but little evidence is forthcoming that the Committee is actively working. The statements themselves are usually of a complacent nature, and express considerable satisfaction at the way the voluntary youth organizations are promoting activities which will guide the young people of the country to fuller and richer lives. One cannot fail to accord a grateful sense of appreciation for the work being carried out by the voluntary organizations; but many of their own workers are seeking both the direction in which the youth policy is to proceed and means to promote the efforts required. This was expressed very clearly recently in a journal devoted to the interests of a boys' movement, when a writer remarked that the only certain fact about our national youth policy was its non-existence. The difficulties confronting those individuals who are only too anxious to undertake service for youth demands confronting with a resolution born of imagination and matter-of-fact realism. In both respects the National Youth Committee could do more to retain and improve the active support of youth workers.

The problem of dispelling doubts about regimentation is one that will demand the use of considerable tact and discretion. In a recent statement in the House of Commons, the President of the Board of Education stated categorically that the last development he wished to see was a centralized movement with rigid uniformity and standardized practice, which placed older boys and girls under the control of some super-functionary in the central Government. Mr. Ramsbottom's disclaimer about militaristic interpretations of the youth scheme was equally strongly worded. It is to be hoped that the action taken, based on these utterances, will serve to dispel the fears of youth workers and to secure their continual and ungrudging support. Probably much of the existing confusion about regimentation lies in the lack of distinction between freedom and discipline. Nevertheless, to establish this distinction to the satisfaction of democrats is not so easy. The main aim should be to fuse the two. Lack of discipline will obviously lead to chaos, and on the other hand absolute freedom is undesirable for it implies freedom of action, expression of opinion, etc., whether right or wrong. Much time is often wasted by the expression of conflicting opinions concerning a problem which to a balanced mind is already settled. There can be few more exasperating than he who claims his freedom to express his opinion merely in order to argue for argument's sake.

The plight of many youths of both sexes who are 'free' to walk aimlessly about or lounge at corners or in queues with no sense of meaning or purpose in life is too well known to need further comment. The most conservative estimates suggest that at least 60 per cent of our young people have no connexion with any single organization, educational, social, or religious. War work has given most of them employment but has not solved their leisure problems and, in some cases, has only intensified them. Their difficulties will not be entirely solved by the extension of the physical fitness scheme on the lines proposed by the Board of Education, nor even by the provision of opportunities for extending their social and cultural interests. Youth needs a sense of significance in life for the individual and the community; suspicions about regimentation need offer no excuse for lack of guidance. The necessity for imaginative planning and disciplinary action is clearly indicated. Already, many youth leaders are advocating compulsory attendance for all young people at some kind of youth organization. At the moment, the execution of such a proposal is probably unwise and equally impracticable; but, as a matter which will inevitably grow in intensity, merits earnest consideration. Its proponents have the fact of compulsory school attendance up to the age of fourteen years to strengthen their case. They are asking, almost with passionate conviction, why, in the most formative years of their lives, when they are acquiring those habits of body, mind and spirit which determine their whole usefulness to themselves and to the community, the majority of our future citizens should be left to the influence, good or bad as it may be, of their surroundings. Whatever the policy adopted it is essential that the spirit of the voluntary organizations with its enthusiasm and informality should be retained and used as the basis for all future developments.

Another matter upon which clearer light might be thrown relates to the activities of local youth committees. Apart from one or two recalcitrant authorities, who may need disciplinary action to call out their initiative in planning for the welfare of the youth of their area, it appears that these committees have now been formed under the ægis of each local education authority. Their constitutional powers, aims, and methods of working have been left to local incentive. Already there is ample evidence that, owing to the cautious utterances of the Board of Education, a great sprawling organism is being formed, both unwieldy and uncontrolled. In some cases these youth committees have been constituted merely in an advisory capacity to the local education committee and themselves possess no statutory powers. In others, sub-committees of local education committees have been formed with full statutory powers, while in yet others entirely independent committees have been created. Whatever the method of constitution, it would seem essential for smooth and successful working that these committees be given sufficient elasticity to allow them to develop their planned programmes without being held too tightly under the control of the education committee. At least one secretary-organizer to each committee would appear the necessary minimum for administrative supervision, while it should be strongly urged that religious leaders with experience in youth work should be given greater representation than has hitherto been apparent. Discreet guidance, combined with more dynamic leadership from the central government, would do much to unify the existing diversities and would serve to stimulate retrograde or passive committees into action which is so urgently required.

The calling into being of these youth committees appears to have proceeded so smoothly—albeit scarcely rapidly—that the complacent references in the Press appear to be well merited. In practice, many local authorities have travelled no farther on the road towards the service of youth than was evident a year ago. Credit must be freely given to those authorities who for some months have been actually promoting youth work. Their enthusiasm and progress should serve as a salutary reminder to the greater number of youth committees, who, up to the present, have functioned in name only. The proposals outlined by the Board of Education a year ago should have been carried to a riper stage than has been reached to-day.

Co-operative understanding between youth committees and the voluntary organizations should do much to promote the welfare of youth. On their side, the youth committees should play their part in seeing that emphasis must never be placed on the consolidation of youth work but on its extension and development. The challenge to the youth organizations will be in seeing that the quality of local work is such that it cannot fail to stimulate youth committees to increasing and active support. In many areas, prominent educationists have been self-confessedly amazed at the quantity and quality of youth work that has been carried out in their own areas for some years past without their knowledge. With the collaboration of the educationists, far-reaching measures can be taken to secure the extension of instructional, cultural, and social facilities of all kinds. Vigorous co-operation with the youth committees should allow the voluntary organizations to become doubly active in promoting courses for the equipment of potential youth leaders. The youth leaders themselves should be continuously engaged in pursuing enquiries as to the needs, interests, industrial occupations, home and surrounding conditions, as well as the usual leisure activities of youth. (In this connexion the parts played by the public cinemas and radio as educative processes must not be forgotten or minimized.)

The need for the carrying out of scientific surveys—similar to the one in progress in Manchester and Salford at present—is of overwhelming importance. Where these surveys are not being envisaged, however, youth leaders can, by discreet inquiry, secure information that will become of increasing value if carefully collated. When the nature and extent of the youth problem has been established, it is to be desired that an intensive drive should be launched to persuade boys and girls unattached to youth organizations to become active participants in youth centres. This drive may eventually become one of personal recruitment before the adolescent has left school. A considerable augmentation of existing youth services would be needed to cater for this project.

One factor which inevitably must serve to promote greater effort in the youth field would lie in a better appreciation by society at large of the amount of work already achieved by the national voluntary organizations. A deeper realization on the parts of educationists, men of science, and all other members of the community that the work in boys' and girls' clubs, etc., is no mere side-issue carried out by zealous individuals with little else to do, would contribute greatly to the extension of youth welfare. The comprehensive development of the national youth movement will rest upon the rapidity with which its absolute necessity and importance becomes impressed upon the mind of the general public.

WORLD BIBLIOGRAPHY

The Subject Index to Periodicals, 1939
Issued by the Library Association. Pp. xi + 270. (London: The Library Association, 1940.) 77*s*.

How seldom do those engaged in developing a new idea for the national effort pause to consider the patient drudgery expended daily in the production of the bibliographical guides whereby to cull the information recorded about that idea. Still less often do they inquire whether these bibliographical aids to research are organized to provide the whole of the relative information recorded. We realize the necessity of finding the best brains for war-time research; but we fail to understand the basic value of a complete index to scientific and technical knowledge. Nor do we appreciate the facts that such an index is not to hand, and that we are wasting time and human lives in repeating work already on record, if we could but find it. The bibliographical work and its organization are accepted as a matter of course. Nothing less than their sudden death seems likely to awaken the necessary interest; though, in war-time, special arrangements have to be made to prevent this calamity, while completeness of the work becomes especially needful.

In regard to the latter desideration, there are two methods by which the fifteen thousand scientific and technical periodicals containing useful articles, published currently in Great Britain and abroad, can be scrutinized regularly and have their worth-while papers abstracted or indexed. Each periodical can have its articles dealt with, working from the beginning to the end of each number as it appears; or, the whole mass of periodicals can be searched from the point of view of each particular branch of knowledge, and those articles relative to each branch picked out. The former method insures that every article is noted; the latter involves greater labour and the risk of missing articles on each subject that appear in periodicals devoted to other subjects, remotely related.

The former method was adopted by the International Catalogue of Scientific Literature. It is the method that appeals to librarians in seeking to catalogue the literature in their libraries. This is the method chosen by the Library Association for the "Subject Index to Periodicals", edited by J. Rowland Powel, of which the 1939 volume is before us. The periodicals indexed in this volume comprise a selection of 577 English and foreign journals and transactions of societies, filed in a number of libraries all over the British Isles, the names of which are quoted in the 1937 and 1938 volumes of this index. The current volume contains some 40,000 references, referring in the main to articles of scientific and technical interest. Verse and fiction are not included. Brief annotations are added to titles not sufficiently indicative of the subject of the articles.

With certain exceptions, journals covered by some of the more important abstracting services are not indexed. Therefore, this work forms a useful supplement to the works of reference published by these bodies and becomes, itself, a necessary adjunct to the library. No praise is needed for the care taken in the preparation of this work now so well known and so much appreciated. The one criticism that many will make is that, like the majority of abstracting and indexing periodicals, it makes use of the alphabetical system of arrangement: a system that scatters, without reason, information on similar subjects, prevents the possibility of incorporating the index as part of a comprehensive index to scientific and technical information and hinders collaboration between the many agencies engaged in this important work of making information available. In the realm of science and technology alone, there are some three hundred abstracting and indexing journals, four fifths of which are arranged alphabetically by different systems and in different languages. These have to be selected and searched separately, volume by volume, and part by part to find what has been recorded about any particular subject, thus multiplying the labour of every inquiry.

When we consider the number of periodicals it scrutinizes and the aggregate of references included, the volume under review represents a great deal of patient labour. What the compilers of most of these works of reference do not consider is the fact their own particular volume contains only a fraction, in this case one twentieth, of the yearly total output of scientific and technical articles, or, say, one thousandth of the references to useful articles published in the last fifty years, and that, necessarily, serious readers must use other works of reference as well. It is important to study how to make each index the most efficient contribution to a comprehensive index to knowledge, in which all the references to any particular topic come together, no matter when or where they were published.

Such an index can, and will, be achieved by the co-operation of indexing agencies. Since its foundation in 1928, the British Society for International Bibliography has worked to secure such collaboration. A National Committee of Representatives of Abstracting and Indexing Services has now been formed by the Society. This committee will investigate and solve the problems involved in indexing every useful article in the world's output of scientific and technical literature, and the associated services will work in free co-operation to produce a comprehensive index. In order that a standard system of indexing may be made available, the British Standards Institution has arranged to publish the fourth edition of Universal Decimal Classification as a British standard. In accordance with the practice of that Institution, each section of the classification will be produced in collaboration with institutions, societies and individuals specially interested, so that the classification will have the approval of expert opinion. The Library Association is represented on the Publication Committee and will give its valuable aid to this great work. Thus there is, at last, good hope that a comprehensive index to knowledge will be achieved and in the most efficient form.

THERMODYNAMICS AND CHEMISTRY

(1) Thermodynamics and Chemistry

By Prof. F. H. Macdougall. Third edition. Pp. ix+491. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

(2) Thermodynamics

For Chemical Engineers. By Prof. Harold C. Weber. Pp. vii+264. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 19*s*. 6*d*. net.

(1) PROF. F. H. MACDOUGALL'S book was recognized in its two previous editions as particularly suited to the needs of students of chemistry, and in the new edition, which has been extensively revised since the appearance of the second edition in 1926, this feature is again maintained.

Apart from minor but useful changes in various parts of the text, the main alterations comprise a much more detailed treatment of fugacity and activity and of the modern theory of strong electrolytes than was contained in previous editions. The last chapter contains a brief but clear account of the methods of calculating thermodynamic functions by statistical methods, and this should serve admirably as an introduction to the larger works on this subject. Examples are given at the ends of the chapters but unfortunately no answers are provided, which seriously diminishes their utility to both students and teachers. As in previous editions, an appreciable part of the book is concerned with phase rule diagrams, and although this provides a welcome break for the student by leading him through easy paths before taking him into the more difficult part of the book which follows, it is doubtful whether this matter is not better dealt with in a separate treatise.

The whole book is carefully written and the standard is high; many rather obscure points which are either not mentioned at all in other works or are not sufficiently explained are here clearly elucidated. As is to be expected, particular emphasis is laid on electrochemistry, since this has contributed so largely to modern research in the fields with which the book deals. Every advanced student of chemistry could read this book with profit.

(2) Prof. H. C. Weber's book strikes a new note in the literature of thermodynamics. The engineer has long made use of the thermodynamic functions but is probably not very familiar with the chemical applications of the subject, and although the chemist has very recently become aware of the immense utility of thermodynamics, he has usually very little knowledge of those parts of the subject which do not deal with systems in equilibrium of the type which he aims at setting up in the laboratory. Such subjects as the flow of fluid, refrigeration, the various types of power-cycles, and the thermodynamics of steam and internal combustion engines, are outside the scope of books devoted to the chemical aspects of thermodynamics. They are, however, vitally important to the chemical engineer.

The present book attempts to correlate these two branches of the subject. It deals with the engineering aspects in a way calculated to attract and inform the chemist, and with the chemical aspects in a form which the engineer would do well to assimilate. In the second field, there are chapters on fugacity and activity, equilibrium constants, partial molal quantities, electrochemistry, and the so-called third law. The book thus lays the foundations of a treatment of thermodynamics which is particularly suited to the chemical engineer. There are good numerical examples at the ends of the chapters but, as is so often the case with American books, no answers are provided.

J. R. PARTINGTON.

FOOD FROM PRODUCER TO CONSUMER

Britain's Food Supplies in Peace and War
A Survey prepared for the Fabian Society by Charles Smith. Pp. x+290. (London: George Routledge and Sons, Ltd., 1940.) 10*s.* 6*d.* net.

THIS book opens with a brief and sound chapter on the need for a food policy. It includes, in separate chapters, data on bread, milk and milk products, eggs, meat, bacon, fish, vegetables and fruit, tea and sugar. The foundation for a food policy must be requirements for health, and the general standard used is the amount required when consumption in lower income groups in Orr's "Food, Health and Income" is raised to that of Group IV, higher groups continuing as before. For milk, the higher scale recommended by the Ministry of Health Advisory Committee on Nutrition is used. These detailed discussions are followed by general chapters on agriculture, distribution, food in war and the improvement of nutrition.

The main interest of the book lies, not on the strictly nutritional side, but in its presentation in concise and clear form of valuable data on the marketing and distribution of food, the structure of food prices and the way in which both production and consumption of essential commodities are controlled by a relatively small number of powerful combines of processing and distributing firms. The extent to which this is the case may surprise the general reader. It is good that he should understand the position. Government attempts at interference have, in some cases at least, strengthened this control.

There is not much reason to expect an important rise in consumption of bread if the price is reduced; rather will money be set free for buying other foodstuffs. That is true and might have been put even more strongly. Among the poor, a rise in the price of bread means more consumption, not less, because bread is the basic energy food against which all others compete. The production of bread is dominated by the millers, chiefly the Millers' Mutual Association which mills 80 per cent of the flour, and the co-operative societies. The price of bread is fixed, within a prescribed scale, by local bakers' associations which, by an extraordinary system of threats of stoppage of flour supplies, arranged apparently with the millers, prevent bakers from selling below that level. The efficiency of the baking industry is often low, and the cost of distribution is extravagantly high. The controlling part played in other industries by groups of processing and distributing firms is equally interesting.

The book is open to criticism on several heads. The text is marred by minor peculiarities, and inconsistencies in the figures quoted occur without comment. It is more disappointing that the author has so often failed to trace the implications of his policy of expansion of production beyond the first stages. For example, when he envisages an expansion of milk production to meet his stated liquid milk requirements and at the same time to maintain a butter and cheese industry in competition with that of New Zealand, he does not appear to appreciate the difficulty under which the dairy industry in Great Britain, with its intensive feeding practice, would compete with that of New Zealand with its extensive system of pasturage. He does not make clear whether he wishes supplies of dairy products from sources outside the Empire to be eliminated. If so, this alone would mean doubling our milk production, and, if we also competed with the Empire on the butter and cheese markets, doubling (with substantial improvements in average yield per cow) or possibly trebling our cow population. In such a case, is he prepared to see the beef market supplied only or chiefly with home-fed cow beef and veal, or would he eliminate imported chilled meat? Expansion of home production of dairy products raises both primary and subsidiary problems of disposal and world price elsewhere. A country which imports two thirds of its food cannot solve the very numerous problems of price and purchasing power which arise by adjustment within its own borders alone. He touches on the problem of the low standard of living in India and the West Indies when he discusses tea and sugar, but neglects it in connexion with the supply of oil-seed concentrates for cattle. To discuss such problems would, however, possibly require a second volume.

In any event, there are plenty of problems within the country which call for solution. It can scarcely be questioned that the country cannot afford the very expensive services of the combines which organize so much of our food supply. The proposals made here cannot be considered as solving more than a small part of the problems and, in particular, not the main problem of adjustment of the earnings of different productive industries, including agriculture, so that they are balanced against each other. But they do direct attention to a number of important points at which economies could be made, even without tackling the bigger problems. The chief of these is the "socialisation" of processing and distribution. There is little room for argument as to the desirability of control. The question of how much of the possible saving should be passed on to the consumer and how much should revert to the producer raises all the attendant issues already suggested.

NUTRIENT SOLUTION CULTURE OF PLANTS

Soilless Culture Simplified
By Prof. Alex Laurie. (Whittlesey House Garden Series.) Pp. xiii + 201 + 14 plates. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 12*s*. 6*d*.

MUCH interest has been aroused in this subject by virtue of the publicity afforded it by the popular Press and by a number of publications, many of which contain statements and claims which are unwarranted. It is refreshing, therefore, to find that the aim of the author of this book is "to present the actual status of the subject; to disabuse the average person, the enthusiastic gardener or the commercial grower of false notions; and to discuss the real possibilities that the field of chemical plant culture promises".

Prof. Laurie considers that before successful soilless culture can be accomplished, the grower must possess a thorough understanding of cultivation in soil. Accordingly, more than a half of the book is devoted to this latter aspect with chapters headed "The Soil and the Functions of Elements", "Nutrient Deficiency Symptoms of some Horticultural Crops", "Fertilisation of Crops in Soil and the Effect of Overdoses", and "How Plants Grow". Whilst there are many interesting details regarding flower culture within these chapters, their presence means that the title of the book does not correctly describe its contents.

From the point of view of nutrient solution culture, there are sections on the growing of crops in sand, growing of plants in "water", growing of crops in gravel and soilless gardening for the amateur.

The author, who is professor of floriculture in the Ohio State University, is mainly concerned with flower cultivation throughout the book, and the technique of growing carnations, sweet peas and other flowers in sand is described. It is noteworthy that satisfactory cropping has been obtained at Ohio when the fertilizer mixture (a complete fertilizer of the 15–3–15 type plus magnesium sulphate) has been applied *dry* to the surface of the sand bed at regular intervals. Such a method obviates the necessity of making up a nutrient solution and the bed requires water only in between fertilizer applications.

Little space is devoted to growing plants in "water", or "tank culture" as the method which has so fired the public imagination is sometimes called. Prof. Laurie points out that most unjustifiable comparisons have been made between plants grown in tanks of nutrient solution and those grown in soil, and is faithfully fulfilling his mission when he states that "No convincing evidence has yet been presented where on a large scale production in the greenhouse, crops grown side by side, one group in water and the other in soil, differed greatly in yields". For the inquiring amateur full details of this particular method are given, and it is pleasing to note the stress laid upon the need for adequate aeration of the nutrient solution when using this technique.

In the Floriculture Department of Ohio University, the sub-irrigation system involving the periodic flooding and draining of beds of gravel with the nutrient solution has found most favour. Consequently, Prof. Laurie gives authoritative details of the many aspects of this method and specific instructions for the growth of a number of flower crops. It is disappointing that in this section, which is the longest chapter on nutrient solution culture in the book, there is no reference to the growing of vegetable or other food plants. Much useful information is included on the construction and use of equipment including pumps and growing media, the formulæ of a number of nutrient solutions and their use, the testing and control of the *p*H of the solution, and the simple determination of some of the elements present.

The book ends with a chapter on soilless gardening for the amateur, and in bold relief is the author's own conclusion that as a hobby it is an interesting and absorbing subject, but that it is not yet ready for development on a large scale by commercial growers who need to look beyond the novel. That excellent flower crops can be grown in purely inorganic media and solutions is well demonstrated, and as Prof. Laurie points out when dealing with the sub-irrigation method "it should be noted that organic matter—so important when plants are grown in soil—becomes unnecessary because its functions are taken care of automatically, and the nutrients are presented in such form as to be readily available to the plant". If this book assists the reader to view in clearer perspective the role of organic matter in relation to the growth of plants, no mean service will have been performed.

W. G. TEMPLEMAN.

THE ORMSKIRK POTATO RESEARCH STATION

By Dr. Redcliffe N. Salaman, F.R.S.

FROM the moment of its inception, the National Institute of Agricultural Botany included the potato as one of its major interests. However, before the Institute had time to formulate a constructive programme the Ministry of Agriculture handed to its care an orphan baby of doubtful parentage but intriguing personality, its wart trials at Ormskirk.

Since 1913, John Snell, a servant of the Ministry of Agriculture, had been conducting potato trials at Ormskirk on behalf of the Ministry, and in close co-operation with the local farmers who, alarmed by the rapid spread of wart disease in the north-western counties, had of their own initiative taken steps to test existing and new varieties of potatoes for immunity to wart disease.

These trials were conducted in the highly infected kitchen garden of the Ormskirk Workhouse. In 1917, Sir Lawrence Weaver, controller of supplies in the Food Production Department, learnt of these trials and obtained Ministry support for an extension of their scope, which was urgently needed. In 1918, Miss Johnston, later Mrs. Snell, joined the staff as chief assistant and remained until 1920.

In 1920 the National Institute of Agricultural Botany, which had itself only come into being in January 1919 took over the wart trials, together with the staff, which was enlarged by the accession of Mr. H. Bryan, formerly horticultural inspector to the Ministry of Agriculture, and Miss Whitehead, later Mrs. McDermott.

In 1920, John Snell died and Mrs. Snell retired. Harold Bryan was appointed in his place; Miss Whitehead, who had been Snell's secretary, now became Bryan's chief assistant. These two officers have been responsible, under the Council, for all the work carried on at Ormskirk until this year, when the Ministry decided to close down the field wart tests. Throughout this entire period Mr. Sharrock, the farm foreman, ably seconded them in all their work.

With the susceptibility trials abolished, the National Institute of Agricultural Botany felt that the Station's *raison d'être* at Ormskirk had also ceased. It was realized that work to which the Council attached the highest importance, such as yield and maturity testing, and the selection of promising seedlings, which Ormskirk had made its own, could, in fact, be conducted to greater advantage in an uninfected area nearer to London and Cambridge. The break with Ormskirk, so far from marking the end of the National Institute's potato work, merely records the close of one stage, successfully accomplished, and the opening of another.

Mr. Bryan, who had been ailing for some time, died in August last, and Mrs. McDermott has been temporarily seconded to the Midland Agricultural Station, where her expert knowledge of varieties will find further, and it is to be hoped an extended, usefulness.

Although the Ministry of Agriculture handed over to the National Institute of Agricultural Botany the task of controlling the testing for wart disease, the expenses of which it defrayed, it still retained the exclusive right of registering immune varieties which had been declared distinct by the Synonym Committee. The consequence has been that for twenty years co-operation between the Ministry and the Institute has been of the closest.

The primary work of the Ormskirk Station was to test all established varieties, both English and foreign, for their reaction to wart disease. At the same time opportunity was offered to breeders to send their seedlings to Ormskirk at an early stage so that their susceptibility might be ascertained and those subject to disease in the field eliminated.

The survey of existing varieties immediately brought to light a state of affairs the existence of which had scarcely been realized and the magnitude of which outstripped the wildest imagination. I allude to what has been called, perhaps somewhat clumsily, the problem of synonymity. The meaning of this term is, according to the Oxford English Dictionary, simple enough, namely, "the identity of nature of things having different names". Thus a variety the original name of which is, let us say, 'Golden Splendour', is, when first put on the market, identified by certain clearly recognized characteristics. Its maturity, skin colour, shape, depth of eye, and the like, together create a picture which lends it an identity of its own and ensures its recognition. We soon found that scores of so-called distinct varieties, bearing every sort of name other than "Golden Splendour", but yet identical with the authentic type, were being sold by seedsmen large and small, with but a few notable exceptions throughout the kingdom.

Snell initiated the battle of the synonyms, but died before the work had got thoroughly under way. The National Institute of Agricultural Botany now took over the task and appointed a committee of experts in 1919 to carry out the work, of which I have been chairman since its inception. The extent of the evil may be gauged by the fact that we found in existence some two hundred synonyms for the variety Up-to-date, and more than ninety each for Abundance and British Queen, whilst many seedsmen's catalogues recorded in glowing terms the superiority of the synonym to the mother stock, with which it had not infrequently shared the same sack in the store-house. In general, the synonym was priced at anything from 20 to 50 per cent or more higher than the original.

To-day the whole nexus of potato synonyms in Great Britain has, practically, been swept away. Much of the credit belongs to the Ormskirk staff; the fight was fierce at first, but such bitterness as there was, was sublimated in the form of newspaper articles and facetious poems addressed to me. Considering its magnitude and universality, the trade must be congratulated on the rapidity with which, when once its eyes were really opened, it rid itself of the evil. If the work at Ormskirk needed any justification, the abolition of potato synonyms alone would be enough, so far-reaching have been its repercussions throughout the whole of the horticultural and agricultural seed trade of Great Britain.

In order to determine the identity of the many hundreds of potato varieties which found their way to Ormskirk, it was necessary to build up as large a collection of existing varieties as possible, a task in which we were greatly assisted by the Scottish Board of Agriculture. This living museum, which contained some sorts which had been in cultivation more than a hundred years, will be preserved. It has been of great service in the training of inspectors to recognize "rogues" in the field.

The reaction to wart disease in the field of the great majority of existing varieties was tested during the first few years of the Station's existence, with the result that Ministry and farmer were henceforth in a position to know which varieties were fit to be grown in infected areas. At once it was evident that a veritable revolution in potato growing was inevitable; so many of the leading favourite varieties were susceptible and hence excluded. Ashleaf Kidney, Epicure, Duke of York, Sharpe's Express, Ninetyfold and Early Regent fell among the earlies, British Queen and Eclipse amongst the second earlies, Up-to-date, President, Magnum Bonum, Fortyfold, King Edward and Northern Star among the lates, to mention but a few of the most widely grown and best-known favourites of the first two decades of this century. Indeed, few really first-class varieties were left in any of the maturity groups.

The discovery of varieties immune to wart disease, first brought to light by Gough in 1908, provided at Ormskirk the basis of a new varietal selection whilst stimulating at the same time breeders in their efforts to fill the yawning gap in the choice of suitable sorts which the official exclusion of susceptible varieties had occasioned in the great wart potato-producing areas of Cheshire, Lancashire and the neighbouring counties.

Foremost among the breeders of new resistant varieties was, and still is, Mr. Donald MacKelvie, who, with others such as Mr. Watson of Messrs. McGill and Smith, Mr. Waight and the late Mr. Lasham of Messrs. Sutton and Sons, have consistently made the fullest use of the Station. Indeed, so great was the output of new seedlings, that it was soon found necessary to institute special seedling susceptibility trials to cope with them. At the same time Mr. J. W. Lesley and myself made use of the Institute's ground and experts, to test the susceptibility of seedlings raised at Barley, Herts, in the course of our research on the genetic inheritance of susceptibility and resistance to wart disease, the results of which were duly published, and gave further guidance to the breeders, many of whom were conversant with the new Mendelian principles.

From the first, Snell, with his magnetic personality, his wide experience and, not least, his gift of the 'winged word', created at Ormskirk an atmosphere hitherto unknown in the 'potato world'. Members of the trade and growers from all parts of the United Kingdom in the autumn flocked to visit Ormskirk and hear Snell, and later Bryan, on whom Snell's mantle fell in rich measure, go round the plots, criticizing and appraising the old and the new. It was realized that with them no sort of interest other than that of the public good and the truth had any weight, and although reputations might be made and lost in one of these visits, during the whole twenty-one years of the Institute's activity there has never been a doubt raised in the mind of any as to the sincerity of the criticism offered, or the integrity of those who uttered them.

Prior to these early Ormskirk days, the potato had been regarded as a useful if rather dull article of food, any interest in which was, in the main, confined to the profits which might accrue in its exploitation. True, the monotony of normal trading might occasionally be broken by some financial boom, the most notorious of which occurred a few years before the Ormskirk activities began. On this occasion an inferior stock of an inferior variety was renamed Eldorado and sold for its weight in gold to a public only too ready to be beguiled. The excitement, the credulity, the folly and the fraud, together with the final dénouement resembled the South Sea Bubble in miniature. The advent of Snell and his successor Bryan, with their candid, not to say caustic, expression of the naked truth, put an end, it is to be hoped for good, to this kind of activity.

A number of circumstances combined to make the first ten years of the post-War period at Ormskirk notable. The stimulus to scientifically inspired breeding, which the presence of wart disease evoked, no less than the forceful personalities first of Snell and then of Bryan gave producer, trader and consumer, a confidence hitherto undreamt of. The genetic and virus research, which from the start found a welcome, induced an atmosphere of scientific and serious endeavour at the Station, whilst its close association with the Committee of Ormskirk Farmers ensured a due appreciation for the strictly practical exigencies of the producer, without which agricultural research in Great Britain need expect but short shrift. It is not too much to say that Ormskirk in these years became almost a place of pilgrimage, the Mecca of the potato-minded. Nor has it been supplanted in the esteem of its frequenters by any other centre. Until to-day, Ormskirk has remained the focal point of the varied interests concerned; what has happened is that those immediate interests have, so to speak, been saturated, and no fresh revolutionary force, with which Ormskirk might be fitted to deal, has arisen. How this saturation has been achieved must now be told.

Two memorials exist which epitomize two aspects of the work so far described, the strictly practical and the applied scientific: I refer to the Lord Derby and the Snell Memorial Medals. In 1915 Lord Derby gave a Gold Medal to be awarded annually by the Ormskirk Potato Society to the raiser of the potato variety best suited to local conditions. The trials took place on the Institute's ground and the merits of the varieties entered were adjudged by the Ormskirk Potato Society alone. In 1924 the Ormskirk farmers invited the National Institute of Agricultural Botany to cooperate with them. Since that time, the trials have become increasingly exacting, and the scope enlarged to include varieties suitable to all potato-growing areas. In particular, the award is no longer based on superiority of yield alone, but much attention is paid to tolerance to virus infection and palatability. The medal has done much to encourage the production of new varieties. Experience has certainly not justified all the awards, whether made before or since 1924. Indeed, it has been found desirable to extend the trials over a period of two years in order to reach a more reliable decision. In regard to both the potato and the medal, the adage that "All is not gold that glitters" has a special lesson, which it has taken many years of painful experience to acquire.

In 1921 the Council of the National Institute of Agricultural Botany decided to strike a Silver Medal to commemorate the pioneer work of John Snell. It was to be given to those who had done outstanding work whether as raiser, cultivator or scientific worker. The recognition of the latter's services is of interest because it covertly discloses the larger and more catholic attitude which the advent of the National Institute has brought about in this particular branch of horticultural endeavour.

In 1922, Spieckermann and Kotthof in Germany, and Miss Mary Glynne in England, developed the method of growing wart tissue *in vitro* with the view of developing controlled experiments on the infectivity of the wart organism and the susceptibility of potato varieties. These methods were further elaborated at Ormskirk in order to carry out rapid susceptibility tests for the convenience of breeders anxious to curtail the two years official field test which hitherto had been considered necessary. Mrs. McDermott devoted much time and attention to this work, and she and Bryan developed a most efficient and economic system of testing. The value of this work was greatly enhanced by the fact that parallel tests were carried out in every case in the field. This practice allowed of a very close comparison of the findings obtained by both methods. In addition they had the advantage of being able to refer specimens in cases of difficulty to Miss Glynne for histological examination. The work of the last twelve years in which every field test at Ormskirk has been duplicated in the glasshouse, has resulted in the complete calibration of glasshouse and field methods. Indeed, it is this very success of the indoor test as developed at Ormskirk which has been the main factor in inducing the Ministry to abandon the Station.

The testing for susceptibility to wart disease brought other advantages in its train: thus, it provided the opportunity of recording accurate descriptions of the botanical characters of the varieties examined, of which full advantage has been taken.

The activities so far described have all been either the direct, or indirect, results of the wart susceptibility trials, but there has been another and distinct line of research which the National Institute of Agricultural Botany has made its own. I refer to the accurate, statistically controlled, trials for the determination of yield and maturity of new and old potato varieties. The procedure underlying these trials was elaborated at Ormskirk and has become general wherever such trials are carried out. Each year several trials for yield or maturity or both, are carried out at Ormskirk and for many years they have been duplicated at Cambridge, Kirton, or elsewhere. In recent years the same trials have been repeated in a second year. The results from all these stations and of each year are carefully correlated. The twenty years of the Ormskirk trials, the results of which are to be found in the Institute's *Journal*, allow of a more or less complete comparison of the chief varieties in use to-day both as regards their yield and maturity.

The yield trials of first earlies have been further elaborated so as to estimate the relative capacity of individual varieties to bulk their tubers early. Such information is of considerable use to the producer who can, if he wishes, grow the variety which will render him the biggest crop at the moment when the markets are offering the highest prices.

Research on the control of eelworm under Prof. R. T. Leiper, of the London School of Tropical Medicine, has been pursued for many years at the Station; for this, however, the National Institute of Agricultural Botany has no official responsibility.

The Station at Ormskirk has a record rich in achievement to its credit; if its closure has brought a measure of disappointment to those who have served it so well, they would do well to take heart in the confident knowledge that the advantages which Ormskirk alone could offer have been exploited to the full, and that the lessons there learnt will assuredly bear even richer fruit when transplanted to another soil.

THE SEARCH FOR TRUTH*

By Prof. H. S. Allen, F.R.S.,
University of St. Andrews

Truth

" 'WHAT is truth,' said jesting Pilate, and would not stay for an answer."

The word has, of course, acquired more specialized meanings, but the root idea is that there should be *agreement* between some statement or belief and some fact or set of facts.

It is consequently not surprising that science has been called the search for truth, but some qualification is desirable, for religion also may be regarded as the search for truth. The mere fact that we hear of the *conflict* between religion and science suggests that we are concerned with two different spheres of thought and activity.

Logic

Logic has been called the science of reasoning or 'the art of thinking'. It was Aristotle who first elaborated this method of examining the reasoning process, a method which is concerned not so much with matters of fact, the things reasoned about, as with the mental operations that are involved in 'thinking'. If, for example, we say, 'All professors are absent-minded', the pure logician has no occasion to decide whether this statement is in accordance with fact. He is concerned only with the abstract form of this proposition. It is because the hypotheses made by the logician are not necessarily in accordance with the facts of experience that many men of science feel suspicious of the results obtained by these methods of reasoning. Readers of Samuel Butler's allegorical and satirical book "Erewhon" will remember that "the Erewhonians were quick to offer up commensense at the shrine of logic".

Two methods of reasoning employed in logic are frequently mentioned in scientific work. They are 'deduction' and 'induction'. The former is described as the method in which reasoning proceeds from generals to particulars, and it is associated with the Greek philosophers who assumed that starting from certain 'innate' ideas it should be possible to deduce particular consequences. The term 'induction' implies reasoning from particulars to generals, that is to say the requisite materials of knowledge are brought to the mind and then analysed.

In these days, when the experimental method of scientific investigation has brought about such astounding revolutions in the life of man, there are very few who would assert that they adhere solely to the deductive process. Even on this old-time 'conflict' a word of caution may be given. A somewhat cynical American physicist has said: "Facts are messy things, which everyone believes except the man who made the experiments; a theory is clear-cut and definite but no one believes it except the man who put it forward".

The Spirit of Research

The motive power of research—to paraphrase Prof. Whitehead—is a conviction that there is a secret, but "a secret which can be unveiled". Now we see in a glass—in a mystery—but then face to face. There is a belief in the mind of every scientific man that there exists a uniformity in Nature, that every occurrence, every phenomenon, "can be correlated with its antecedents in a perfectly definite way", and that the connexion illustrates general principles. The discovery of such correlations is what is meant by the term 'explanation'.

---

*Based on an address to the Mathematical and Physical Society of the University of St. Andrews.

When, however, we turn to the examination of these explanations, we find that the influence of preconceived ideas is often overwhelming. For example, in the days of Galileo the following argument was put forward (to quote Chiaramonti) to rebut the movement of the earth round the sun:

"Angels cause Saturn, Jupiter, and the Sun to move, and the Earth also, if it does move must be moved by angels in its centre. But in that centre of the Earth dwell devils. Therefore devils would have to move the Earth—which is impossible".

Here is an extract from a remarkable letter written by Galileo as a reply to a momentous letter from his old pupil, Castelli, at that time professor at Pisa.*

"Holy Scripture and Nature are both emanations from the Divine Word: the former dictated by the Holy Spirit; the latter, the executrix of God's commands. Holy Scripture has to be accommodated to the common understanding in many things which differ in reality from the terms used in speaking of them. But Nature, being on the contrary inexorable and immutable, and caring not one jot whether her secret reasons and modes of operation be above or below the capacity of men's understanding: it appears that, as she never transgresses her own laws, those natural effects which the experience of our senses places before our eyes, or which we infer from adequate demonstration, are in no wise to be revoked because of certain passages of Scripture which may be turned and twisted into a thousand different meanings. For Scripture is not bound to such severe laws as those by which Nature is ruled".

It is interesting to compare the spirit of this letter with the attitude of one of the greatest of scientific investigators, Michael Faraday, of whom Tyndall once said that when he opened the door of his oratory, he closed that of his laboratory. The candid historian of science, in the nineteenth century at least, cannot afford to overlook the fact that many of the most prominent investigators in Great Britain were men who were brought up in a devout atmosphere, and of these, several professed their belief in religious principles.

Scientific Explanation

It used to be said that "any solution of a physical problem which satisfies *all* the conditions is *the* solution". In these days we should be more cautious in making such a statement. For example, in dealing with the problems of quantum mechanics three different mathematical methods have been applied with success: the method of matrices, the method of quantum algebra as developed by Dirac, and the method of wave mechanics due mainly to Schrödinger. It may be said that these are only mathematical variations; but before the modern developments had been reached, few would have ventured to prophesy that such far-reaching results could be obtained by such apparently different methods.

There is, however, another objection to the dictum which says that the solution must satisfy *all* the conditions. In general it is difficult, or perhaps impossible, to state what are the exact conditions that must be satisfied. Such a statement would be possible only for an omniscient being. An excellent illustration is the attempt to form an estimate of the age of the earth. I quote from a recent lecture by Prof. W. Peddie.

At the time of Kelvin's calculation of the age of the earth "only one sufficient source of the earth's internal store of heat was known; and he showed, by conclusive dynamical reasoning, that the resulting age of the earth could not exceed a few hundred millions of years. When the heating effect of the radioactive substances present in the rocks forming the crust of the earth became known, a large extension of the age of the earth, sufficiently large to satisfy geological specialists, became available. At once an outcry arose regarding the supposed failure of Kelvin's dynamical reasoning and conclusions. There was no failure. Sir Oliver Lodge pointed this out, and the clamour at once ceased. Although at the time of Kelvin's work there was not the faintest idea of the possible existence of any other sufficient source of heat than that considered by him, nevertheless, careful as Newton, Kelvin prefixed his calculation by a clear statement of his postulates—If no hitherto unknown source of energy exists. No one knew better than he that assumption lies at the root of all philosophy. His perception of a possibility constituted practically a successful prediction".

Conflicts of Science

Although theology has been called the divine science, it will be convenient for our present purposes to take the more familiar use of the word science and use it to describe our knowledge of the physical or material world. Prof. Whitehead points out that during the last half century the results of science and the beliefs of religion seem to have come into a position of frank disagreement, but he directs attention to the fact that this is no new thing. "In the first place, there has always been a conflict between religion and science; and in the second place, both religion and science have always been in a state of continual development."

---

* The correspondence is quoted in full in C. R. Gibson's "Heroes of Science" (Seely, Service and Co., 1913).

"Science is even more changeable than theology. No man of science could subscribe without qualification to Galileo's beliefs, or to Newton's beliefs, or to all his own scientific beliefs of ten years ago."

"Galileo said that the earth moves and that the sun is fixed; the Inquisition said that the earth is fixed and the sun moves; and Newtonian astronomers, adopting an absolute theory of space, said that both the sun and the earth move. But now we say that any one of these three statements is equally true, provided that you have fixed your sense of 'rest' and 'motion' in the way required by the statement adopted."

Another example may be taken from the theories as to the physical nature of light. "Newton's theory was that a beam of light consists of a stream of very minute particles. . . . Huygen's theory was that light consists of very minute waves of trembling in an all-pervading ether." "To-day there is one large group of phenomena which can be explained only on the wave theory, and another large group which can be explained only on the corpuscular theory. Scientists have to leave it at that, and wait for the future, in the hope of attaining some wider vision which reconciles both." This was written in 1925 not long after Louis de Broglie had introduced those new ideas which have led to the development of wave mechanics. He wrote: "If, then, we boldly assume that waves and corpuscles are always closely associated in Nature, then the motion of any corpuscle must always be associated with the propagation of a wave. . . ." This general theory of the connexion between corpuscles and their associated waves is the foundation on which wave mechanics has been built up.

According to Prof. Niels Bohr, we must employ "complementary" descriptions to account for phenomena on the atomic scale. For example, the corpuscular picture and the wave picture "are certainly complementary, but at the same time, taken strictly incompatible". Each description is an "idealization" permitting us to represent certain aspects of the nature of light, but not all the aspects at the same time.

Shall we adopt the corpuscular picture of light of the wave picture, the quantum theory or the classical theory? In his presidential address to the British Association at Glasgow in 1928, Sir William Bragg suggested that the student of physics might adopt the one hypothesis on Mondays, Wednesdays, and Fridays and the other on Tuesdays, Thursdays, and Saturdays. If we accept Heisenberg's 'principle of indeterminacy' the position is changed. This may perhaps be illustrated by the story of a distinguished Edinburgh professor who met a colleague on the South Bridge and engaged in earnest conversation. At the end he asked "Can you tell me which way I was going when I met you? I forget whether I have had my lunch". The professor of physics who sets out to determine the energy of an electron accurately on Monday morning may soon be at a loss to know whether he is experimenting on Monday or Tuesday; if he wishes to secure *very* great accuracy he may be in a fog as to whether it is 'this year, next year, some time or never'. Energy and time are 'complementary' magnitudes, and when we gain accuracy with respect to the first we lose it with respect to the second.

SCIENCE AND RELIGION

If, and when, we are inclined to stress the apparent conflict between religion and science, we should carefully bear in mind that in science itself there has been one outstanding example of a conflict dating back at least to the days of the Greek philosophers. This is the problem of continuity and discontinuity. How is it possible to reconcile the existence of individual elements—atoms, electrons, protons—which are regarded as indivisible and capable of being counted, with our intuitive ideas about time and space which we have regarded as continuous? It is only within the last few years that light has been thrown on this crucial problem by the work of Heisenberg summed up in his Principle of Uncertainty or Indeterminancy, and by that of Bohr expressed by the word 'complementarity'. We are compelled to use in physics conceptions that are essentially contradictory, but we must use them in an appropriate and limited sphere. It should therefore occasion little surprise if in questions of æsthetics, ethics or religion we meet with other conflicts.

In his Gifford Lectures entitled "The Faith of a Moralist", Prof. A. E. Taylor said: "In an age in which scepticism—a languid scepticism—about the 'certainties' of science, not so long apparently the most assured of all 'certainties' has become the favourite intellectual attitude of the 'educated public', our most crying intellectual need, perhaps, is the need of men who will by their robust assertions, arouse us, not from our 'dogmatic', but from our lazily anti-dogmatic 'slumbers'. There was something heroic about the temper of the 'Mid-Victorian' time, with its cry of

> It fortifies my soul to know
> That though I perish, truth is so."

In our search for truth we shall not succeed if we bandy about catch-words and slogans. Let us beware especially of all -isms, whether political or religious, such terms as socialism, capitalism, communism or Victorian liberalism and conservatism. Even the word 'democracy' is unsatisfying and does not suggest a sufficiently high ideal. It *may* be used as a cloak to conceal a plan for the domination of minority by a majority. Let us get back to the simple and fundamental ideas embodied in some degree in all religions worthy of the name. Freedom is better than slavery, mercy is better than cruelty, righteousness is better than injustice, good is better than evil.

REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS*

By Prof. Enrico Fermi,
Columbia University

THE nuclear reaction produced by neutron bombardment in heavy elements can be conveniently described, according to Bohr, with the assumption that, as soon as the bombarding neutron strikes the nucleus, it is incorporated into the nuclear structure with the formation of the so-called compound nucleus. This is a relatively stable system in the sense that its life-time is very long compared with the frequencies of nuclear particles ; in an absolute sense, however, the life-time is very short, being sometimes of the order of 10^{-12} sec. and sometimes much less.

The ultimate result of the nuclear reaction depends upon the way in which the compound nucleus disintegrates. This mode of further disintegration depends in its turn, for any given nucleus, essentially upon the energy content of the compound nucleus. When the bombarding neutrons are slow, the energy of the compound nucleus is equal to the binding energy of the neutron in the nucleus. Apart from irregular fluctuations from nucleus to nucleus, this binding energy has a general variation with the atomic number and is a maximum for elements of atomic weight about 40, where it is on the average about 9 Mev. From there on it decreases more or less regularly up to the heaviest elements, where it attains an average value of about 5 Mev. If the bombarding neutrons are fast, their kinetic energy must be added to the binding energy to obtain the total excitation energy of the compound nucleus.

The compound nucleus can lose its excitation energy by emission of a particle (neutron, proton, alpha particle or photon) or, in the case of the heaviest elements thorium, protoactinium and uranium, it may disintegrate by fission into two approximately equal parts. Apart from this latter case, the most probable processes for medium weight and heavy elements is the emission of photons and of neutrons. Emission of protons and of alpha particles requires a much greater energy on account of the Gamow potential that the particle must overcome before coming out of the nucleus. Furthermore, in a nucleus containing one hundred or more particles, even when this energy is available, it is unlikely that it should all be concentrated in one single alpha particle or proton in order to give to it sufficient energy to escape from the nucleus. It is much more probable that a neutron would be emitted instead, since a much lower concentration of energy is sufficient in this case.

The relative probability of the emission of a photon or of a neutron depends mainly on the energy. When the energy is barely larger than the binding energy of the neutron, as in the case of bombardment with slow neutrons, a photon is usually emitted. If, instead, the energy of the compound nucleus exceeds by a considerable amount the binding energy of the neutron, as in the case of bombardment with fast neutrons, the emission of a neutron from the compound nucleus becomes the most probable process. Even when the excess of energy is very large, it is improbable that the outcoming neutron carries away all the energy that is available ; indeed one would expect theoretically that the escaping neutron has a small probability of coming out with an energy in excess of 2 Mev. In most cases, therefore, the nucleus remaining after one neutron has been emitted by the compound nucleus will still be in an excited state. The emission of one or more photons or, when the residual excitation energy is sufficient, of a second neutron (n, $2n$-reaction) will then occur before the nucleus reaches a stable configuration.

---

* A paper presented in a symposium on "Nuclear Physics" held on September 19 during the Bicentennial Conference of the University of Pennsylvania.

Compound nuclei of the very heaviest elements may also disintegrate by fission. This form of disintegration is made possible by the large amount of energy released by splitting a heavy nucleus into two approximately equal parts. In this respect we may say that all heavy nuclei are unstable. Their practical stability is, however, insured by the fact that the two fission fragments must overcome a practically impassable Gamow barrier for separation. In the case of uranium and thorium, the height of this barrier is no longer so great, and what prevents spontaneous fission is probably the large mass of the fission fragments, which gives a very low penetrability even to a barrier which is not very high. The relatively low excitation due to the arrival of a neutron is sufficient in these cases to excite the compound nucleus into a state above the top of the potential barrier or so near the top that the fission process becomes possible. It should be noticed in this respect that the bare extension of the Gamow mechanism of the potential barrier is probably not the only one that is responsible for the high stability of uranium with respect to the fission process; probably also other factors, as, for example, the low probability that the nucleus should take such a configuration as to make possible the transition into two fragments, play an important part in ensuring this stability.

It follows from this discussion that the most probable types of nuclear reactions in heavy elements under neutron bombardment are the following: (n, γ), produced especially by slow neutrons; (n, $2n$), produced only by very fast neutrons; fission produced only in the heaviest elements by fast and, in one case, also by slow neutrons.

Uranium is a typical example of this behaviour, because in this element all three types of reactions are observed. The (n, γ) reactions was discovered by Hahn and Meitner, who recognized that among the active products produced in uranium by neutron bombardment, one, with a period of 23 minutes, produced by a typical resonance process is carried by an isotope of uranium. The assignment of the atomic weight of this isotope as 239 has been confirmed by direct experiment by Nier, Booth, Dunning and Grosse. U^{230} disintegrates into an isotope of element 93, which is also radioactive with a period of 2·3 days, as proved by the investigation of Abelson and McMillan. When uranium is bombarded with very high energy neutrons, an (n, $2n$)-reaction may take place, the final result of which is the formation of an isotope 237 from the main isotope 238 of uranium. This nuclear reaction has been recently reported by Nishina, and others by McMillan; they found for this isotope a period of 7 days.

The most interesting reaction produced by neutrons in uranium is the fission process which occurs both in the isotope 238 and in the rarer isotope 235. Since the fission process has been already the object of many discussions, I shall limit myself here to the consideration of only one aspect of this phenomenon. The chemical investigation of the radioactive products of fission has proved the existence of a very large number of radio-elements, indicating that the fission can occur in a number of different ways. We are thus led to the conclusion that, after the compound nucleus is formed by adding a neutron to uranium, the actual splitting of the nucleus may lead to different pairs of fragments; each one of them gives rise to a chain of radioactive elements having on the average three or four elements.

It was early recognized that the simple theory of the fission process fails to represent the detailed results, in so far as the splitting does not occur into two equal fragments, but rather into fragments in which one is somewhat lighter and one is somewhat heavier. We have therefore to distinguish between a light and a heavy group of fragments. Presumably a fragment belonging to the light group and a fragment belonging to the heavy group are emitted in the same act. The problem arises now to determine what percentage of the fissions of uranium gives rise to the formation of a certain radioactive product, or rather of a certain radioactive chain. Since it is expected that in every fission a chain belonging to the heavier group and a chain belonging to the lighter group are formed, we would expect a total percentage of 100 for each of the two groups, except for the improbable direct formation of a stable fragment.

Since very little quantitative information is available as to the relative intensities of the various fission products, Anderson, Grosse and I undertook last spring a systematic investigation of this problem. Our purpose was to make a preliminary survey, and the results obtained so far cover most of the known radio-elements of the heavy group. The method used consisted in comparing the intensities of various radioactive products obtained by chemical separations from uranium samples irradiated under standard conditions and for a known length of time with the Columbia cyclotron. A known fraction of each radio-element was separated and brought near a counter; the activity was deduced from the number of counts, corrected in order to take into account the absorption by the counter walls and the various geometrical factors. We have thus been able to assign the percentage of fissions of most of the chains of reactions belonging to the heavy group. They vary from a minimum of about 0·1 per cent to a maximum somewhat more than 10 per cent. The percentages found so far for the heavy group do not add up to 100, but are about one half of that. Apart from experimental errors, which can be quite considerable in measurements of this kind, this fact is probably due to the incomplete chemical investigation of this group. Probably some more radioactive elements of the heavy group, possibly belonging to the rare earths, have yet to be discovered and analysed.

THE TOTAL SOLAR ECLIPSE OF OCTOBER 1

BY DR. H. SPENCER JONES, F.R.S.,

ASTRONOMER ROYAL

THE weather conditions throughout the belt of totality in South Africa at the time of the total eclipse of October 1 were favourable and came up to the highest expectations. Dr. J. Jackson, H.M. Astronomer at the Cape, who made observations at Calvinia, described the eclipse as the best of the four that he had seen, and a perfect one in every way for astronomical observations. The sky was cloudless throughout and there was not even a breeze to shake the instruments. The conditions in the clear dry air of the arid regions of the Lower Karroo had promised to be so good that, before the War, extensive preparations had been made for observations to be made in this area by parties from Great Britain, Holland, the United States and elsewhere. It is unfortunate that the plans were almost completely upset by the War and that at a time when theoretical advance is dependent upon information that the eclipse observations were expected to provide, so favourable an opportunity has in large measure been lost.

The eclipse attracted much popular attention in South Africa. Railway traffic to the eclipse area was very heavy, many special trains being run. The few main roads leading to the belt of totality were congested with many thousands of cars. The limited accommodation in hotels and boarding houses was fully booked, but most of the spectators camped in tents on hills and rising ground where they could see the eclipse to the best advantage. The Prime Minister of the Union, General Smuts, who is a member of the Astronomical Society of South Africa, spared time from his many duties to fly from Pretoria to Cradock to view the eclipse, which he saw under excellent conditions. The most favoured place for watching the eclipse as a spectacle was from the escarpment of the plateau above Van Rhyns Pass, where the high plateau falls away abruptly and without warning to the Namaqua plain 2,300 ft. below. The scene was described as follows in a letter from a correspondent in South Africa:

"We climbed to the top of the Pass, 2,300 feet, and there found on the Plateau a vast encampment: tents, camp fires, hundreds of cars (which grew into thousands), flags, lorries of oranges (for the orange season is in full swing and the scent of blossoms showered into the dusty road as we passed along, for the trees are at all stages), a red cross hut, an A.A. van, even the road scraper with a red flag at each corner had crept up to see the sight. The next morning there were many more cars, and a steady stream, nose to tail, creeping up the Pass, those still on the long road across the plain below lost in a continuous cloud of dust. The heat was grilling. The strata of the mountains is horizontal and resulted in a series, flat topped, even more sheer against the skyline than Table Mountain. It is a savage, dry, primitive place. We looked across the plain, seeing some forty miles distant from our vantage point. A plan, flat as a table, not an acre of cultivation in sight, dun coloured silt it appeared, with markings on the surface, like a picture of the moon without the craters. It was very still, a quite perfect day for all the astronomers wanted to do. A thread of cloud, a whiff, low on the horizon, that was all. After the eclipse had begun we did not notice for some time any appreciable diminution of light and heat. Then, at last, the drama really began. At its height the mountains were inky black, a pale star or two appeared, a great shadow moved stealthily across the plain, a rim of orange light appeared above the horizon and pale yellow above it, and gradually this new dawn rose. We saw the details of the mountains again and the watching thousands. A little wind which had risen, lay down again as the sun progressively emerged. We watched the endless stream of cars passing down the Pass, the dust cloud grew and grew until we could only define the road by the stream of dust, far across the plain and round the farthest mountain."

The darkness at mid-totality is described as not being so great as had been expected, and the light exceeded that of the full moon. The astronomers, however, found the eclipse a darker one than usual. Dr. H. E. Wood, the Union Astronomer, who observed the eclipse at Cradock, described the sky as a dark grey. He states that the planet Mercury, and Antares, the Southern Cross and its pointers and Arcturus could be seen. The corona appeared as a pearly white halo, almost devoid of colour, with long streamers of shimmering silver grey. Three streamers showed on the lower left-hand side of the sun, at least two and a half times the diameter of the sun in length; other long streamers reached upwards. The keen-eyed noticed faint pink prominences, but most of the watchers failed to detect these. Dr. Jackson attributed the general lack of colour to the exceptional clearness of the atmosphere. Totality is stated to have been two seconds shorter than was expected. A national broadcast commentary on the eclipse was made from Cradock by the South African Broadcasting Corporation, English and Afrikaans commentaries being broadcast simultaneously on different wave-lengths.

The party from the Cape Observatory, under the direction of Dr. Jackson, made observations of the Einstein deflection. Two instruments were used. One was a portable equatorial stand, which had been sent out from the Royal Observatory, Greenwich, on which was mounted the 13-in. objective and breech-end of the astrographic refractor of the Cape Observatory. With this instrument, the eclipse field and a specially selected adjacent field were photographed on the same plate; the eclipse plates are to be compared with plates of the same fields obtained three months previously. The eclipse field on this occasion was far from being ideal, but it was expected that exposures of fifteen seconds of the eclipsed sun and five seconds on the adjacent field, with the objective stopped down to an aperture of 7 inches, would show sufficient stars for a reasonably good determination of the displacement. The adjacent field is used to fix the scale of the plates and this scale is then used for the eclipse field to determine the displacement. The advantage of this method is that the stars in the two fields are at about the same distance from the plate centre, so that optical distortion effects, which depend on distance from the plate centre, are eliminated. With this equipment, the three months interval between obtaining the comparison plates and the eclipse was used by Dr. Stoy, of the Cape Observatory, in a photometric programme of observations for direct comparison between photometric standards in the northern and southern skies.

The other instrument was a horizontal camera with a 7-in. photographic lens of 17-ft. focus, fed by a coelostat with a Pyrex mirror. The plates cover a large field and with this instrument the usual procedure of using the distant stars essentially for fixing the scale of the plate and the close stars for determining the Einstein deflection was followed. The complicating factor in this method is that the optical distortions are different for the two sets of stars. The results are not yet available but information has been received from Dr. Jackson that the plates show considerable fogging. As the stars in the eclipse field are faint, the accuracy of measurement will unfortunately be impaired. But even though the observations do not provide any improvement on earlier determinations of the Einstein deflection, the experience gained of the method of photographing two fields on the same plate during the eclipse should be of value. The writer had planned to use this method at Christmas Island in 1922, but cloud prevented any observations being obtained, and the method has not since been tried.

Spectroscopic observations with a moving plate camera were made, also at Calvinia, by Dr. R. O. Redman, of the Radcliffe Observatory, Pretoria, assisted by the Radcliffe Travelling Fellow, Dr. H. Zanstra, of the Netherlands. The moving-plate camera, which was to have been used by the party from the Solar Physics Observatory, Cambridge, was sent out to South Africa for use by the Radcliffe observers. The purpose of the observations was to photograph the transition from the Fraunhofer to the chromospheric spectrum. In order to eliminate disturbing effects caused by the fall in temperature during the progress of the eclipse, the spectograph was set up in a pit 10 ft. deep, in which the temperature changes were small. The cabled information is that Dr. Redman is pleased with the observations obtained, so that some results of value may be expected when the photometry of the spectra has been completed.

Two instruments were used by Dr. C. W. Allen, of the Commonwealth Solar Observatory, Canberra. With a spectrograph designed to give high light-collecting power, the flash and coronal spectra were photographed. A polarigraph was also used, with which the corona was photographed through blue and red filters, in order to determine the degree of polarization in the corona with a view of throwing fresh light on the important question as to the nature of the reflecting particles in the corona. Successful observations, with which Dr. Allen is pleased, were obtained.

Though, therefore, a much reduced programme of astronomical observations was possible, the perfect conditions under which these observations were made give hope that results of importance will follow and that these will prove of value in the theoretical study of the sun's chromosphere and corona. All these observations have been made possible by grants from the Government Grant Fund, administered by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. The Government of the Union of South Africa also made a contribution towards the expenses of transport of the equipment in South Africa.

In addition to the astronomical observations, Mr. Higgs of the Commonwealth Solar Observatory made radio observations at Victoria West, throughout the eclipse, at intervals of 2½ minutes by means of an automatic recording equipment, to obtain P'–f data, with the aid of a grant from the Radio Research Board of the Australian Council for Scientific and Industrial Research. Radio investigations had also been planned by Dr. B. F. J. Schonland of the Geophysical Institute of the University of the Witwatersrand, but no information about these has yet been received.

OBITUARIES

Sir Robert Hadfield, Bart., F.R.S.

THE death of Sir Robert Hadfield in his eighty-second year on September 30 removes a notable figure from the world of science and of industry. To the outside public he was probably better known than any other metallurgist, while his striking personality and capacity for making friends, together with his activity as a writer and as a correspondent, made his circle of colleagues exceptionally wide.

Robert Abbott Hadfield came of a Derbyshire family long associated with Sheffield. His father, Robert Hadfield, after gaining experience in several branches of the steel industry, set up a works in 1872 for the production of steel castings, at that time a somewhat bold experiment. The business was successful, and the castings, which included hydraulic cylinders of large size to replace the much heavier cast iron, gained gold medals at several international exhibitions. Robert Hadfield died in 1888 when only fifty-seven, after several years of failing health. His son, who had been trained as a chemist and had worked for a time in the firm of Jonas, Meyer and Colver, set up a laboratory in his father's works, and took control of the undertaking when only twenty-four years old. On succeeding his father, the business was converted into a limited company. Steel castings have always remained a speciality of the firm, but even in its early days attention was given to the manufacture of steel projectiles, formerly obtained from France. In time, the undertaking grew to be one of the greatest of armament works, although its products covered a much wider range.

Hadfield's interest in alloy steels arose from reading a publication by the Terre Noire Company on alloys of manganese. In the systematic way which characterized all his work, he studied the effect of progressive additions of manganese on carbon steels. It was known that small additions hardened the steel, but that when the manganese reached about 3 per cent the alloys were so brittle as to be useless. This was confirmed, but the research was carried further, with the surprising result that when 12–13 per cent was reached, an alloy having entirely novel properties was obtained. This new steel was made softer instead of harder by quenching, was non-magnetic, and presented an extraordinary resistance to wear, becoming hard on the surface under abrasion. This, the 'manganese steel' of to-day, was discovered in 1882, a full scientific account of it being given to the Institution of Civil Engineers in 1888. It came into extensive use for railway and tramway crossings, crushing machinery, etc., a well-known application being the protective helmets introduced in the War of 1914–18. The steel is now known to be of the austenitic class, but certain of its properties are still anomalous.

In the same systematic manner, Hadfield examined the influence of silicon, and this research led to the introduction of the low-carbon silicon steels, which proved to have valuable electrical properties, including high resistance and low hysteresis. Their use made a marked saving in the weight of transformers. Later, Hadfield made similar surveys of the alloys of iron with nickel, chromium and tungsten, providing much valuable information but without leading to any alloy of entirely novel properties. He continued his studies of manganese steels over many years and published a number of further papers.

In the early controversies on the hardening of steel, Hadfield took an active part, supporting Prof. Arnold in his insistence on the influence of carbon against those who laid the chief stress on the allotropy of iron, and he lived long enough to see the true elements in both views incorporated into the modern theory.

The direction of a great industrial undertaking, of which he was chairman from 1888 onwards, did not check Hadfield's devotion to the scientific side of metallurgy. He made many friends among scientific men at home and abroad, and was able to interest them in problems concerning metals. Thus he published papers in collaboration with Sir William Barrett, Prof. W. Brown and Sir Ambrose Fleming on the magnetic properties of alloy steels, and with Sir James Dewar and also with Prof. W. J. de Haas on the properties of metals at very low temperatures. He was keenly interested in the history of metallurgy, and besides making a fine collection of old metallurgical books, he examined and described such typical ancient objects as the famous iron pillar at Delhi, his most exhaustive investigation in this field being that of the alloys of iron prepared by Faraday and preserved at the Royal Institution. This was published in book form in 1931.

Sir Robert Hadfield received many honours. He was knighted in 1908 and received a baronetcy in 1917. He became a fellow of the Royal Society in 1909, and was an honorary member of a great number of technical societies, many of which conferred on him their highest honours. He was president of the Iron and Steel Institute in 1905–7, and of the Faraday Society from 1913 until 1920, and those societies with which he was connected have reason to remember the keen attention which he gave to his duties and his boundless hospitality. Few men have worked so hard and with such system throughout a long life. He was an enlightened employer and a good citizen of Sheffield, where he occupied the position of Master Cutler in 1899–1900, being the second of his family to hold that office. He was a generous benefactor to the University of Sheffield and to other institutions, and gave much kindly encouragement to younger research workers. Shortly after the War of 1914–18 he put forward a scheme for an Empire Development Board, to which he gave much thought and energy. In 1894 he married Frances Bett, daughter of Colonel Samuel M. Wickersham, of Philadelphia. Lady Hadfield, who was created C.B.E. in 1918, worked from 1914 onwards in a hospital which she and her husband founded at Wimereux, and this work was continued during the present War as the Hadfield-Spears Ambulance.

C. H. Desch.

Dr. William Bowie

William Bowie, who died on August 28, aged sixty-eight, was best known in Great Britain perhaps as one of the most significant personalities of the International Union of Geodesy and Geophysics. For fourteen years he was the president of the Association of Geodesy, for three he was president of the Union itself, and at the last General Assembly (Washington, 1939) he undertook the duties of the general secretary, who had been recalled to England on the outbreak of war. His influence upon the Union was not confined to his mastery of geodesy or to his eminent work in isostasy, widely known and appreciated as these are. It rested just as much upon an enthusiasm and a strength of purpose which compelled co-operation and stifled the minor jealousies which are apt to clog the wheels of international work. It was a difficult matter to succeed the late Ch. Lallemand who led the Union so brilliantly for fourteen years, but Dr. Bowie did, in fact, add to, rather than diminish, the significance of that post, because his geophysical interests were unusually wide and he could envisage no future in which geodesy did not work hand in glove with geophysics.

The United States Coast and Geodetic Survey has earned the gratitude of all surveyors. It has given us the 'figure of the earth' now used in all international work. It has followed and greatly enlarged upon, the fine record of the Survey of India in developing isostasy. It has shown how geodesy may be subjected to mass production without losing precision. Even its observing towers and lamps came as something refreshing, efficient, simple, and practical. Dr. Bowie was the colleague of, and successor to, John F. Hayford in all these matters, and in our minds is also successor to Alexander Ross Clarke and Everest.

Dr. Bowie entered the U.S. Coast and Geodetic Survey in 1895 and served for forty-two years, of which twenty-eight were as chief of the Division of Geodesy. During the War of 1914–18 he served in the Engineers as a major in the mapping division, and this association with army and with mapping matters lasted until his death. He served on the federal "Board of Surveys and Maps" from 1920 onwards. Probably no one of his generation has more practically and strenuously studied and forwarded a mapping suited to the administrative, economic and industrial development of his country.

In 1919 the American Geophysical Union was founded. Dr. Bowie was its general secretary and, later, president. In his hands it grew in membership from fifty to thirteen hundred, and spread its influence over every territory of the United States. His services to that Union are commemorated by the William Bowie Medal, of which the first award fell, appropriately, to himself.

It would serve small purpose to list the twelve societies over which Bowie had presided or the even longer list of honours and awards which his own country had given to him. He had been honoured also by Belgium, Holland, and Yugoslavia. Edinburgh admitted him, in 1936, to the degree of doctor of laws. More even can be said of him as a strong, able, single-minded man devoted to the advancement of science, and, withal, a singularly likable friend.

H. St. J. L. Winterbotham.

Rev. Dr. W. G. Ivens

We regret to record the death of the Rev. Dr. Walter George Ivens, well known as an authority on the languages and ethnology of Melanesia.

After graduating at the University of New Zealand, Ivens joined the Melanesian Mission and laboured as a priest in Melanesia for a period of forty years. During this time he became widely known among scholars for his wide and profound knowledge of the numerous languages of Melanesia, as well as for his intimate acquaintance with their manners, customs, religious beliefs and observances. His "Melanesians of the South-East Solomon Islands" (1927), excellent in many respects, was followed three years later by the far more weighty "The Island Builders of the Pacific" (1930), in which, though it deals with a specialized form of culture, a certain breadth of philosophic outlook provokes reflection.

Dr. Ivens held the degree of Doctor of Letters of the Universities of New Zealand and Melbourne. During 1924–28 he was a research fellow of the University of Melbourne and during 1928–35 travelling secretary of the Melanesian Mission. He was a lecturer at the School of Oriental Studies in the University of London in 1936.

NEWS AND VIEWS

The Right Hon. Neville Chamberlain, M.P., F.R.S.

The death of Mr. Neville Chamberlain on November 9, occurring at so short an interval after his retirement from political life, has afforded him little opportunity for the enjoyment of that leisure that he had earned by his strenuous life as industrialist in the West Indies and in Birmingham, and as a politician and member of His Majesty's Government under several administrations as well as during his own tenure of office as Prime Minister during 1937–May 1940. Mr. Chamberlain entered upon the administration of national affairs at a disadvantage. His work for social betterment and in municipal affairs in Birmingham, which led up to his election as Lord Mayor in 1915, attracted the notice of those in authority in the conduct of national affairs during the War of 1914–18. They called him to a wider field; but his acceptance of office as Minister of National Service in 1917 resulted only in frustrated effort and resignation owing to the fact that he occupied no seat in Parliament. His entry into the House of Commons at the General Election of 1918 determined his activities for the remainder of his life, the greater part of which from that time was passed in office.

Like his father, Joseph Chamberlain, Neville Chamberlain was a striking example of the successful business man to whom the organization of his commercial or industrial interests affords, or did afford, leisure in middle or later life to engage in public affairs—as Bagehot noted, a characteristic peculiar to English public life. In estimating the value of Chamberlain's work as statesman and as a contribution to the welfare of the people of Great Britain, his fame might well rest assured on his tenure of office for five years as Minister of Health under Mr. Baldwin. He passed no fewer than twenty-eight Bills through Parliament in this period—measures dealing with housing, slum clearance on a national scale, old age pensions, rating and valuation, local government reform, and the like. This achievement, however, was overshadowed by subsequent events. As Chancellor of the Exchequer from 1931 onward he took in hand the Herculean task of setting the finances of the country on a sound basis in face of a world-wide economic collapse. When he became Prime Minister in 1937 the financial standing and integrity of Great Britain was as high, or even higher than ever before in the estimation of the world.

The tragedies of the three years 1937–40 need no recapitulation. The death knell of the League of Nations as a political force had already sounded when Mr. Chamberlain accepted office as Prime Minister, and he turned to the policy of 'appeasement' and the formation of a 'peace front'. The policy achieved its greatest success with Mr. Chamberlain's almost superhuman effort at Munich which was "to secure peace in our time"—and it was its greatest failure. The cynical sale of Russia's influence to the highest bidder destroyed the possibility of a peace front in eastern Europe; the tragedy of Czechoslovakia and the treacherous onslaught on Poland showed the futility of faith in the promises of the dictators. Notwithstanding the criticisms of Chamberlain's achievement at Munich and the disappointment at his misunderstanding of his opponents' true character, it is safe to predict that from this very failure his reputation as a great representative of all that is best in the English people will grow. As is shown by his record in peace-time, he was a practical idealist with an inextinguishable enthusiasm for the betterment of the human lot and a belief in the fundamental integrity of the individual. It is to such men, and not to the doctrinaire, that we must now look for the practical measures which will bring about the reconstruction of a post-War world; and in this the example of Chamberlain's work of social reform will endure. If he failed to secure peace it was because, being an honest and upright man, untrained in the methods of gangster diplomacy, he failed to appreciate the possibilities of treachery in those who use promises and solemn undertakings as counters to secure ignoble ends.

Although the career of Mr. Neville Chamberlain was political, a considerable amount of his time was devoted to amateur natural history. In his younger days, about 1902, he was a keen member of the old Birmingham Entomological Society, and he used to exhibit at its meetings which were held at Avebury House, Newall Street. He was usually in company with his uncle, Alderman George Kendrick, a well-known local entomologist, and Mr. Chamberlain made a special study of the camouflage of pug moths which he collected from the railings of his father's house, "Highbury", at Moseley. He also made extensive collections of the Geometræ. In later years in London he maintained this interest in entomology and recorded the wood-leopard moth in the garden in Downing Street; but then his interests were more devoted to ornithology and he contributed to the annual report on the bird sanctuaries in the Royal parks, published by H.M. Stationery Office, 1936, noting pied wagtails in St. James's Park and large flocks of redwings during the frost. St. James's Park was his special venue, where his early morning walks during his office as war-time premier were reminiscent of the walks of the late Lord Grey of Fallodon during the War of 1914–18. In addition to the pied wagtail and the redwing, Mr. Chamberlain recorded the lesser black-backed gull, the carrion-crow, the swift, the kestrel, the grey wagtail and the wheatear in St. James's Park. He also recorded a melanic form of pied wagtail in Downing Street, and in the garden common to No. 10 and No. 11 he maintained a bird table and bird-boxes, inducing the blue tit to nest there, and blackbirds and song thrushes to become resident. He also shared Lord Grey's fondness for fly-fishing.

Earthquake in Rumania

Early on the morning of November 10, a very intense earthquake shook nearly all Rumania, and was also felt in Sofia, Belgrade, and many other places in the Balkan States. It will be recalled that a strong double earthquake was felt for about 30 seconds in Bucharest on October 22 (see Nature, Nov. 9, p. 615), and that this was at the time thought to be the precursor of a stronger shock. Evidently the supposition was correct, though the time interval between the premonitory shock and the now much stronger one was greater than anticipated.

Although small earthquakes and tremors are by no means unknown in Rumania, that country has in the past not been so severely hit by these catastrophes as other Balkan States such as Greece. The shock of October 22 may have had its epicentre near Barlag, though some damage was done in Bucharest, the capital. The present shock again severely affected the capital, where many famous buildings are reported damaged and destroyed, and where the casualties are probably high. From other towns, including some in the region of the oil wells, damage and casualties are also reported. A further earthquake, said to have caused enormous damage and many casualties, included among whom were rescue parties working amid the debris of the first earthquake, occurred early on November 11.

Youth Service Corps

In a circular to local authorities (H.M. Stationery Office, 2*d*.) the Board of Education sets out a new scheme for the physical training of youth between the ages of fourteen and twenty. The ultimate aim is not the creation of a new movement but the co-ordination of already organized local units, the resulting corps to be run by the young people themselves. Arrangements have been made with the War Office for the gradual release, so far as military requirements allow, of experienced leaders, organizers and certain physical training instructors. All available premises, such as gymnasia, halls, playing-fields, sports grounds and swimming-baths, will be utilized. The supply of suitable clothing is also considered. Suggestions concerning methods of appealing to the youth of the country are also given; these include appeals to those leaving school, old scholars' associations, evening institutes, youth rallies, the "Fitness for Service" scheme, contact with industrial workers, and general publicity. A badge scheme is also outlined.

The Suez Canal

Nature seventy-one years ago (1, 81; 1869) recorded the opening of the Suez Canal "in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished *savants* invited from the East and from the West". The question of the canal has, however, dated back to a much earlier period. Tradition has it that Alexander first discussed its feasibility, but decided against it on account of the difficulty of the mouth of the canal becoming silted up. After other projects, the first Napoleon revived the idea, and from that time the question of a ship canal became a standing topic. With progress in the sciences, especially those of immediate bearing such as geology and engineering, the possibility became more and more convincing, and culminated in the opening on November 17, 1869, the result of one of the greatest of modern engineering feats. It may be well to think of the difficulties faced by science at the time, which in the "pre-scientific age rendered man's contests against the works of the winds and sea perfectly hopeless" but with the aid of science were now conquered.

Greece

The Greek Mathematical Society has sent an appeal for help and sympathy to the whole brotherhood of mathematicians, in the name of "the birthplace of mathematics, the country of Pythagoras, Plato, Euclid, Archimedes and Apollonius". Not only the mathematician, but also every scholar and scientific man should answer to the call. Of those five great men it so happens that one was born in Sidon and another in Damascus, another in Perga, and the greatest of all in Sicily; nevertheless Greece has a right to claim and speak for them all. In her golden age they contributed to her glory, and her language has preserved their teaching for the world. Greece herself has had five distracted centuries since Byzantium fell, and her fugitive scholars brought the Renaissance into Europe. Even the last hundred years, since Byron and his Philhellenes fought for her independence, have been hard and troubled times. But in the last few years order has reigned, and much has been done. The University of Athens has quickly become a flourishing institution. Her laboratories are busy, her own library and other lesser libraries are rich, the museums there and elsewhere are well kept and beautiful. We may think not only of what she did two thousand years ago, but also honestly admire her part in the art and science and letters of to-day. Great Britain is again on Greece's side, and the readers of Nature not least of all.

The Next Total Solar Eclipse

With the October 1 total eclipse of the sun now past (see p. 642 of this issue), and observations in South America at least ruined by clouds, some astronomers will now be looking forward to their next chance. This will come on September 21, 1941. Plans are uncertain at present, because the best place from which to see it will be on the coast of China, between Foochow and Wenchow, as well as farther inland, at Hankow and Nanchang. Whether certain foreign astronomers will be able to set up their instruments there by next September is perhaps rather questionable. The tip of the moon's shadow next September 21 will first touch earth at sunrise in Russia near Astrakhan. Then it will cross the Caspian Sea, the Aral Sea, Turkestan, Tibet and China. After that it will pass across the western Pacific Ocean, including the American island of Guam. Here the sun will be blacked out for about two and a half minutes, or fifty seconds less than in China, but this would still give time for many valuable observations.

The Earl of Rosse (1840-1908)

Among the noblemen who during the nineteenth century devoted themselves to scientific pursuits, few were better known than the third and fourth Earls of Rosse. The former constructed the famous reflecting telescope at Birr Castle, King's Co., Ireland, and from 1848 until 1854 was president of the Royal Society, while the latter carried on his father's observations on nebulæ, made investigations on the heat radiated from the moon and held important offices in Ireland. Sir Laurence Parsons, the fourth Earl, was born at Birr Castle on November 17, a century ago, and was the eldest of six sons, of whom the youngest was Sir Charles Parsons, of steam turbine fame. Educated partly at home, he graduated from Trinity College, Dublin, at the age of twenty-four, and three years later, on his father's death, succeeded to the title and estates. From early manhood he took a part in public life, and in 1885 was made chancellor of the University of Dublin; in 1887 he became president of the Royal Dublin Society and in 1895 president of the Royal Irish Academy. He was a fellow of the Royal Society and of the Royal Astronomical Society from 1867.

Among engineers Lord Rosse was known for the unswerving support he gave his brother in the difficult pioneering work on the steam turbine, and was a director of the Marine Steam Turbine Company formed in 1894 to construct the historic *Turbinia*. In Mr. Rollo Appleyard's biography of Sir Charles Parsons are many letters to Lord Rosse relating to the steam turbine, which he lived to see adopted for the *Dreadnought*, the *Mauretania* and *Lusitania*. A man of wide interests, a generous employer and a philanthropist, Lord Rosse died at Birr Castle on August 30, 1908. By his will he left a sum of money for the upkeep of the telescopes and instruments made famous by his father.

Dr. James Finlayson

Dr. James Finlayson, an eminent Glasgow physician and medical historian, was born on November 22, 1840, at Glasgow, where he received his medical education and qualified in 1867 with a thesis on "The value of quantitative methods of investigation in medicine and the allied sciences". In 1871 he was elected fellow of the Faculty of Physicians and Surgeons of Glasgow and a few years later its honorary librarian, in which capacity he served the faculty for more than a quarter of a century. In 1875 he was appointed physician to the Glasgow Western Infirmary, where he taught medicine until his death, and from 1883 until 1898 he was physician to the Glasgow Royal Hospital for Sick Children. In 1899 he was elected vice-president and in 1900 president of the Faculty of Physicians and Surgeons, and made an honorary LL.D. of the University of Glasgow. His writings covered the whole range of medicine, but his chief work was his "Clinical Manual for the Study of Medical Cases", of which the first edition appeared in 1878 and the fourth and posthumous edition in 1926. He also wrote the chapter in Keating's Cyclopædia on the diagnosis of children's diseases (1889). He took a lively interest in the history of medicine, and from 1892 to 1895 gave a number of bibliographical demonstrations on Hippocrates, Galen, Celsus, Herophilus and Erasistratus. His most important historical publications were the "Account of the Life and Works of Maister Peter Lowe (1889), the founder of the Faculty of Physicians and Surgeons, Glasgow", and the "Account of the Life and Works of Dr. Roland Watt, author of the Bibliotheca Britannica" (1897). He died suddenly on October 9, 1906.

Morbidity and Death-Rates in Great Britain

The issue of the *Lancet* of November 2 contains an instructive article on this subject by Dr. Percy Stocks, medical statistical officer to the General Register Office, who shows that the standardized death-rate from all causes was not so large in the March quarter of 1940 as in the severe winter quarter of 1929, but it was above that of any intervening quarter. Very high rates were returned in several large towns. The adjusted death-rate in those great towns which served as reception areas, after a temporary increase probably due to influx of many infirm persons, has fallen relatively to that in Greater London and the evacuation towns. During the autumn and winter when schools were closed in evacuation areas and partly closed in neutral areas, the diphtheria notification indices among children in London and the evacuation towns were only half those of a previous year compared with a decline of 17 per cent in the reception and 22 per cent in the neutral towns, but there was no equivalent reduction in the death-rate. In the June quarter when schools reopened the contrast between evacuation and reception towns ceased.

The scarlet fever notification index during the March quarter in the evacuation towns was less than half that of a previous year, compared with a fall of 31 per cent in the reception towns, and this position did not change when the schools reopened in the June quarter. Measles and whooping-cough deaths during the March and June quarters amounted in the evacuation towns as well as in Greater London to a very small fraction of the numbers in the previous years; the reception towns showed little change, and the neutral towns a moderate fall. The measles notification rate per 1,000 children under 15 in the evacuation towns was only 6 in the March quarter, rising to 25 in the June quarter when the schools reopened, compared with 59 and 48 respectively in the reception towns. The whooping-cough notification rate was half as great in the evacuation towns as in the reception towns in both quarters, the neutral group being intermediate. The cerebrospinal fever notification rate at all ages and the death-rate at ages over 15 during the March quarter were higher in the reception towns than elsewhere, but this was not maintained in the June quarter.

Scientific Training and Administration

At a meeting of the Institute of Fuel held on October 17, an address was delivered by Mr. W. H. Selvey, who has been acting president during the absence in the United States of Colonel J. H. M. Creenly. Among other matters, Mr. Selvey spoke of scientific invention and its application to the life of a country. He said that it is generally twenty years or even longer before scientific knowledge produces practical applications which enter into the common life of the country. We should consider what kind of men should ultimately compose that small inner coterie, existing in every country, which has the power and responsibility of putting great forces into action. Those men to-day are primarily educated in what is called the 'humanities', a form of education which leads to an astute knowledge of how to govern men through their lesser qualities, sometimes even their weaknesses. The growing reaction against this form of education of some of the finest minds has led, not to a change in their education but in replacing them by representatives of the 'people', mostly great-hearted men, but possessing this in common with colleagues of the former type, that in discussions of any grave difficulty they can always brush aside questions which demand answers by saying that they are purely technical.

It is a surprising state of affairs that, in a world which is fast becoming wholly technical, those possessing power and responsibility seem almost to boast of their ignorance of technical questions. There are countries, however, where those in real power are technically trained as a basis for their future activities, educated to a certain extent in the scholastic field of knowledge, but totally devoid of morals when acting as functionaries of the State. The jibe that technologists do not make successful administrators will, so long as government turns on the management of men by their foibles, always contain an element of truth. The matter must be dealt with at an earlier stage. It is not more difficult to distinguish between young technologists than among young classical graduates, which men are likely to develop into administrators. There is a growing consciousness that something must be changed before it is safe to put further powers evolved by scientific workers and technologists in the hands of those governing the political fortunes of the State. But men of science and technologists must go on; therefore they must themselves delve deeper into those questions which they, in turn, have been equally amiss in shelving as political, moral, ethical and religious.

British Empire Naturalists' Association

Since the suspension of *Country-Side*, the quarterly journal of the British Empire Naturalists' Association, due to the War and paper shortage, its duplicated quarterly *Branch News* has considerably extended its circulation and has become the official war-time organ of the Association under the editorship of the organizing secretary, Mr. Leslie Beckett, and it is still produced and issued from 22 South Drive, Ruislip, Middlesex. The new October issue outlines a scheme by which this duplicated news-sheet will be circulated to all who desire it in return for four stamped addressed envelopes a year. This will reduce the heavy clerical work as well as the expense. The current sixteenth issue records the rare crimson variety of *Erica cinerea* and *Orchis purpurea* in mid-Kent, the black redstart successfully nesting in London near Westminster Abbey and singing in Piccadilly, elephant hawk moth larvæ feeding on orange balsam in Surrey, an adult male Montague's harrier, green-, wood- and curlew-sandpipers, ruff, little stint, garganey, greenshank, pochard and shoveller among the autumn passage birds at Slough Sewage Farm, Bucks, while a summary of the British Empire Naturalists' Association's summer field meeting held in the Ludlow district of Shropshire notes the pied flycatcher and the sandpiper found nesting and hundreds of plants of *Astrantia major* found in full bloom. It is hoped to arrange the usual midsummer meeting in 1941. A request is made to collect certain herbs to aid botanical drug importers faced with the stoppage of imported Continental supplies; but these will be plants abundant everywhere and not likely to injure the flora of the countryside. Although many of the branches are finding difficulties from air raids and war-time duties of members hindering their meetings, activity is still being maintained and meetings held by the branches for London, Middlesex, Merseyside, Norfolk, mid-Kent, south Devon, Derbyshire and north Lancashire.

Traditional Culture and Individuality in Britain

A study of "The Celtic West" by Prof. H. J. Fleure (*J. Roy. Soc. Arts*, **88**, Oct. 4, 1940) will add strength to the arguments of those who urge that the lowering of national barriers in the interests of co-operation in international affairs should not be allowed to obliterate those cultural differences and diversity of ideas by which intellectual advancement largely has been promoted in the past. "The value of personality," says Prof. Fleure, "is now felt to be the essential for which we are fighting, and, in this respect, we can learn a good deal from the Celtic west." He points out, indeed, that although "the Celtic race" is a term both unscientific and in point of historic fact incorrect, the tradition of the Celtic west conserves a pattern in which are woven strands of many ages, some perhaps 4,000 years old. The purpose of his argument is to show that this traditional pattern has contributed to the cultural life of Great Britain something which is lacking in the English-speaking regions of the country.

In England there has been a failure to afford the skill of the rural worker opportunities to adapt itself to modern conditions—a verdict which will be endorsed by all who have watched the decay of rural arts and crafts in our country districts. In the Celtic west, however, something of the old life of the peasantry survives. It is manifested not merely in adaptability to a variety of manual tasks, but also intellectually in an abiding interest in the deeper and more spiritual sides of life—"a peasant heritage that is even now struggling to escape destruction". It is in this aspect in particular that Prof. Fleure finds the lesson of the culture of Wales, which he points out has afforded the people opportunities for the expression of their individuality in the fields of oratory, poetry and song. Through these our common British life has gained vastly from the spring of an ancient cultural tradition. By this tradition even the miners of South Wales have been preserved from the worst evils of industrialism. How to keep this contribution to our common life from submergence, Prof. Fleure concludes, is a problem worthy of much study.

Aerial Ropeway in Central Sweden

An aerial ropeway of exceptional length is being built in Central Sweden for the purpose of conveying limestone from quarries to a new cement factory. From a description given in *Engineering* of October 18, we learn that the ropeway is 28 miles in length, and will be capable of transporting 700,000 tons of material per annum. The running, filling and emptying of the 550 skips used is carried out entirely automatically. The construction work is now well advanced; the supporting towers have been erected along the entire route, and the work of placing the cable in position has now begun. Several difficult problems have been successfully solved. One of these was the best way to convey the ropeway across two wide waterways. In one case this has necessitated the suspension of the ropeway at a height of 22 metres to enable ships to pass freely underneath. In addition to carrying the line across a lake, concrete towers, 147 ft. 7 in. in height, have had to be built in the water. It is anticipated that the installation will be completed by the end of the present year.

Mental Hygiene of Old Age

In a recent paper (*Mental Hygiene*, 24, 734; 1940) Dr. Nolan D. C. Lewis, director of the New York State Psychiatric Institute and Hospital, New York City, makes the following recommendations for avoiding or relieving the mental troubles of old age. In the first place, the senile individual should be used economically by arrangement of changes of work and frequent rest periods. The individual should be relieved so far as possible from worry, mental strain, anxiety and feelings of financial insecurity. With the gradually devitalizing processes in mind, special care should be taken to avoid physical discomforts, vitiated air, infections and over-eating. The senile patient should also be protected from injuries, as they may produce or increase a tendency to hypochondria. It is important to avoid any heavy burden on the sense organs through which exhaustion of the central nervous system may occur. The younger and more able associates of the senile individual should make allowances for the occasional lack of acuity in dealing with situations which require fine discrimination and tact. Tolerance and understanding should be used with the aged person who shows a marked egoism together with uneasiness, restlessness and a tendency to harp on his difficulties.

Folk-lore of the U.S.S.R.

The Academy of Sciences of the U.S.S.R. is to issue a new work entitled "Soviet Folk-lore", into the compilation of which has gone much effort on the part of many expeditions to different parts of the Soviet Union. An expedition sent out to the Stalingrad Province by the University of Leningrad has collected much interesting material relating to the folk-lore of the Don Cossacks. In the villages and farmsteads of that province the expedition recorded 110 folk-tales, 550 Cossack songs, as well as numerous proverbs and legends. Among the songs are some about Stepan Razin, Yermak, Peter the Great and the War of 1812. This expedition has also collected interesting material relating to the new Soviet folk-lore of the Don Cossacks. Records were made of songs and tales on the subjects of Stalin, Voroshilov, Budenny, the Civil War and the collective farm.

Adams Prize: Subject for 1941–42

The Adams Prize, which is open to the competition of all persons, including women, who have at any time been admitted to a degree in the University of Cambridge, is awarded for an essay, the subject proposed for the period 1941–42 being "The theory of the elementary physical particles and their interactions". The essay may contain a discussion of the properties of some or all of the elementary physical particles and of their associated fields; the theory of cosmic rays and the structure of nuclei come under the scope of the subject. The value of the Prize is about £288, but may be increased, when it seems desirable to the adjudicators, on occasions when the prize is divided. Provision is also made for the award of extra Adams Prizes in suitable cases. The essays must be sent to the Registrary of the University on or before December 31, 1942.

Comet Okabayasi

Harvard College Observatory Card 539 reports the discovery of a comet of magnitude 11 on October 4 by Okabayasi. *Card* 540 gives the following elements and orbit computed by Miss Scott at Berkeley:

$$\begin{array}{lll} T & 1940 \text{ August } 11 \cdot 979 & \\ \omega & 320^\circ\ 40' & \\ \Omega & 125\ \ \ 59 & \\ i & 131\ \ \ 25 & \\ q & 0 \cdot 9730 & \end{array} \quad \text{with } \omega, \Omega, i \left.\vphantom{\begin{array}{l}1\\1\\1\end{array}}\right\} 1940$$

Announcements

Mr. Francis Druce has resigned the honorary treasurership of the Linnean Society after serving for nearly ten years. On November 7 the Society elected as his successor Major F. C. Stern.

The Rockefeller Foundation, the Carnegie Corporation and other United States bodies have guaranteed £125,000 to take to America a hundred leading scholars who have fled from Germany.

Errata. In the article on "Early Explorers of Southern South America from the United States" in Nature of August 17, p. 238, line 5, for "Stongington" read "Stonington", and line 8 for "Jerimiah N. Reynolds" read "Jeremiah N. Reynolds".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

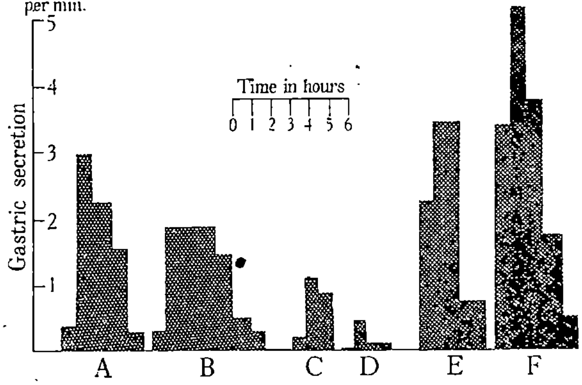
In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Activity of Carbonic Anhydrase in Relation to Gastric Secretion

It has been shown recently by Davenport[1] that the gastric mucosa of mammals is very rich in carbonic anhydrase, which seems to be localized in the parietal cells. According to Davenport, this observation together with some other considerations suggested the possibility that carbonic anhydrase takes part in the secretion of hydrochloric acid. According to this view, carbonic anhydrase catalyses the hydration of carbon dioxide to carbonic acid, which ionizes to H^+ and HCO_3^- ions. The H^+ ions are concentrated and secreted while HCO_3^- ions pass into the blood to replace the chloride ions which accompany hydrogen ions. "If carbonic anhydrase in the gastric mucosa were inhibited the chain of reactions would be interrupted, and the mucosa would be unable to secrete acid"[2]. This clearly suggests that the validity of this theory of gastric secretion can easily be tested by means of a suitable inhibitor of carbonic anhydrase.

It is obvious that substances such as potassium cyanide, hydrogen sulphide and sodium azide which strongly inhibit carbonic anhydrase cannot be used for this purpose, because being unspecific they inhibit also the activity of several other important catalytic systems of cells. It has been demonstrated, however, by Davenport that thiocyanate ions inhibit to about the same degree both the activity of carbonic anhydrase and the gastric secretion of hydrochloric acid induced by histamine. These observations have been brought forward by him as strong additional evidence supporting the view that carbonic anhydrase plays an important part in the gastric secretion of hydrochloric acid.

It was shown recently by Mann and Keilin[3] that carbonic anhydrase is very strongly inhibited by sulphanilamide and that this inhibition is reversible and highly specific. Moreover, the inhibition of this enzyme by sulphanilamide is of a much higher order of magnitude than that by thiocyanate. Sulphanilamide forms, therefore, a most valuable reagent in the study of the physiological significance of carbonic anhydrase in the blood and in the gastric mucosa. In the present communication we shall deal, however, only with the problem of the interrelationship between carbonic anhydrase and the gastric secretion of hydrochloric acid.



Gastric secretion of hydrochloric acid in six cats induced by injection of 0·5 mgm. histamine per kgm.: *A* and *B*, controls; *C* and *D*, after injection of sodium thiocyanate; *E* and *F*, after injection of sulphanilamide.

Our experiments were carried out on cats starved for about 15 hours. Under ether anæsthesia, the brain was pithed from an opening made in the second vertebra. Artificial respiration was then applied while the administration of ether was discontinued. The cardiac end of the stomach was ligatured and a cannula was tied into its pyloric end, taking special care to preserve the normal blood circulation of the stomach intact[4]. Sodium thiocyanate (0·2 gm./kgm.) or sulphanilamide (1 gm./kgm.) were injected intravenously one to two hours before the subcutaneous injection of histamine dichloride (0·5 mgm./kgm.). The stomach was washed, filled with 20 c.c. of warm saline solution which, every 40–50 minutes, was removed, titrated for free hydrochloric acid and replaced with fresh solution.

Cats		Gastric secretion of			Gastric mucosa	
		Free acid (c.c. *m*/100 HCl)	NaCNS mgm.	Sphmd. mgm.	NaCNS (*M*.)	Sphmd. (*M*.)
Controls	*A*	379				
	B	291				
Injected with sodium thiocyanate	*C*	29	4·4		$2 \cdot 7 \times 10^{-3}$	
	D	96	7·0		$1 \cdot 8 \times 10^{-3}$	
Injected with sulphanilamide (Sphmd.)	*E*	443		287		$7 \cdot 2 \times 10^{-3}$
	F	736		174		$2 \cdot 3 \times 10^{-3}$

Thiocyanate and sulphanilamide were estimated in the successive samples of saline solution removed from the stomach (see accompanying table) and in samples of blood, where their concentrations until the end of the experiment were never lower than $4 \times 10^{-3} M$ and $6{\cdot}4 \times 10^{-3} M$ respectively. At the end of the experiment the blood vessels of the stomach were perfused with saline solution, the stomach removed, the gastric mucosa separated from the muscular coat, ground with sand and ten volumes of water and centrifuged. The opalescent extract collected was estimated in the usual way for the activity of carbonic anhydrase and for the contents of thiocyanate or of sulphanilamide. Control cats were treated in the same way except that they were not injected with either thiocyanate or sulphanilamide.

The main results of these experiments, typical examples of which are shown in the figure and the table, can be summarized as follows:

(1) Both thiocyanate and sulphanilamide are excreted by the gastric mucosa and reach a fairly high concentration within the mucosa itself. It is therefore reasonable to assume that they have reached the carbonic anhydrase and had time to react with it.

(2) Thiocyanate, while it strongly depresses the gastric secretion of hydrochloric acid stimulated by histamine, is not a strong inhibitor of the carbonic anhydrase.

(3) Sulphanilamide, on the contrary, while it either does not affect the secretion of hydrochloric acid stimulated by histamine, or even increases it, inhibits completely the activity of the gastric carbonic anhydrase.

The results of these experiments do not seem therefore to support the view that carbonic anhydrase catalyses directly the gastric secretion of hydrochloric acid. This does not exclude, however, the possibility that the enzyme may yet have an indirect connexion with the gastric secretion of HCl, considering that this secretion is known to be accompanied by an increase in the total base of the serum[5,6]. That the carbonic anhydrase takes part in the acid-base metabolism of the body is moreover indicated by the well-known disturbance in the acid-base equilibrium which follows the administration of sulphanilamide.

W. FELDBERG.
D. KEILIN.
T. MANN.

Physiological Laboratory,
and
Molteno Institute,
University of Cambridge.
Oct. 30.

---

[1] Davenport, H. W., *J. Physiol.*, **97**, 32 (1939).

[2] Davenport, H. W., *Amer. J. Physiol.*, **129**, 505 (1940).

[3] Mann, T., and Keilin, D., NATURE, **146**, 164 (1940).

[4] Edkins, J. S., *J. Physiol.*, **34**, 133 (1906).

[5] Gamble, J. L., and McIver, M. A., *Proc. Soc. Exp. Biol. Med.*, **23**, 439 (1926).

[6] Bulger, H. A., Allen, D., and Harrison, L. B., *J. Clinic. Invest.*, **5**, 561 (1928).

Blood Groups of Anthropoids

CANDELA[1] has collected previous data on the blood grouping of 137 anthropoids, and added 11 more of his own, based on urine tests. 99 of the animals are chimpanzees, in which only groups O and A have so far been found. In the orang, gorilla, and several gibbon species all members belong to groups A, B or AB. This distribution in them is shown in the accompanying table.

Genus	O	A	B	AB	AB (calc.)
Orang	0	8	10	5	11·41
Gorilla	0	6	3	2	5·09
Gibbon	0	2	7	2	4·36

The last column gives the numbers of AB animals expected if there were random mating within the genus the members of which are grouped together. For in the absence of group O we can be reasonably sure that all, or almost all, A and B animals were homozygous, if the genetics of blood groups are the same in apes as in men. Thus of 46 orang chromosomes 21 carried A and 25 B. If mating were at random we should expect a frequency $\frac{2 \times 21 \times 25}{46^2}$ of AB among orangs, or 11·41 out of 23. The total of AB found is 9, as compared with 20·86 calculated. The difference is 3·6 times its standard error, and certainly significant.

The non-randomness of mating may be due to the existence in these genera, as in man, of different blood group frequencies in different areas, or to inbreeding, or both. A fairly intense degree of inbreeding would be needed to halve the expected proportion of heterozygotes. This would, for example, occur if 80 per cent of all matings were between brother and sister, the rest being at random. It is at least equally probable that the distribution of blood groups in these genera varies geographically at least as much as in man. Unfortunately many of the papers in the literature do not even give the species or subspecies of anthropoid investigated, and very few if any give the place of capture or those of the wild ancestors.

Hence no conclusion on this matter is possible. It is of importance that these data should be given in all future work, if only because their results may throw light on the origin of the differences between human races as regards blood group membership. The chimpanzee, of which 99 have already been grouped, seems to be much the most hopeful animal for this purpose. It is the object of this note to direct the attention of workers in this field to so important a desideratum.

J. B. S. HALDANE.

University College,
Gower Street,
London, W.C.1.
Oct. 28.

---

[1] Candela, P. B., *Amer. J. Phys. Anthrop.*, **27**, 2 (1940).

Function of Nicotinic Acid in the Metabolism of the Colon-Typhoid Group of Bacteria

WE have already[1] presented data indicating that nicotinic acid does not act as a specific 'growth factor' in the limited sense, but as a part of an activator of glucose fermentation. In the semi-synthetic medium used, growth of *S. paratyphi* A. and *Shigella dysenteriæ* Shiga occurred in the absence of nicotinic acid; however, when glucose was added to this medium, active fermentation took place only when nicotinic acid was added. In order to test the validity of this conclusion, these studies were extended to include other fermentable substances under a variety of conditions. The full results will be published elsewhere, but we wish to direct attention now to a number of points of special interest.

(*a*) Using the photo-electric colorimeter for measuring growth density (a more accurate method than naked eye observation and much simpler than the plate-count method) we noted the following paradoxical effects : (i) Glucose added to our medium free of nicotinic acid inhibits growth ; growth was better in the absence than in the presence of glucose. This inhibiting effect was produced by all sugars fermented by the organisms used in the experiments, with the exception of maltose ; and conversely it was not produced by sugars such as sucrose not fermented by these organisms. (ii) Similarly, nicotinic acid added to the medium in the absence of a fermentable sugar or acid (lactic or acetic) inhibits growth. The inhibitive effect of the nicotinic acid is produced by such minimal concentrations as are still effective in influencing fermentation when fermentable sugars are present.

These effects are illustrated by typical results given in Table 1.

Table 1. GROWTH DENSITY IN THE BASIC MEDIUM AND WITH THE VARIOUS ADDITIONAL SUBSTANCES ADDED.

Without nicotinic acid		With nicotinic acid	
Medium	Growth density*	Medium	Growth density
Sterile medium	100	Sterile medium	100
Basic medium	84	Basic medium	90
,, + glucose 0·01%	97	,, + glucose 0·01%	77
,, ,, 0·05%	97	,, ,, 0·05%	63
,, ,, 0·20%	97	,, ,, 0·20%	65
,, + maltose 0·2 %	88	,, + maltose 0·2 %	70
,, + sucrose 0·2 %	84	,, + sucrose 0·2 %	90

* The numbers indicate the relative growth density ; the highest numbers represent least turbidity, and conversely.

(*b*) The addition of nicotinic acid to media containing a fermentable sugar or acid (lactic or acetic) is followed by active fermentation leading to a breakdown of the substance : (i) When glucose is used, lactic and acetic acid and carbon dioxide are the principal products. (ii) When sodium lactate is used, the end products depend on whether or not nicotinic acid is present. In the latter case, a small part of the lactic acid is oxidized to acetic acid, but the process goes no further ; in the former case, that is when nicotinic acid is added, complete oxidation of the lactic acid results and the acetic acid is converted to carbon dioxide, that is, carbonates. In lactic acid – containing media to which a suitable indicator is added, no change in reaction occurs in the absence of nicotinic acid, while a marked alkaline reaction is developed in the presence of nicotinic acid. The density of growth parallels the intensity of fermentation.

(*c*) By means of dehydrogenation experiments by the Thunberg procedure with washed cells (using lactate as donator), it was possible to show that organisms grown in glucose or lactate media with nicotinic acid reduced methylene blue, while those grown in media without nicotinic acid failed to reduce methylene blue. If the washed organisms used in the system were grown in the presence of glucose or sodium lactate, together with even minimal amounts of nicotinic acid (0·005 γ/c.c.), they reduced methylene blue fairly promptly. If the washed bacteria were grown in the absence of nicotinic acid, and then nicotinic acid added to the respiration system, the reduction was delayed and occurred only after an incubation time which was at least twice that required by the control culture grown in the presence of nicotinic acid. It seems, therefore, that the nicotinic acid is first converted into a codehydrase (cozymase ?) before it can act. Some typical data are shown in Table 2.

Table 2. REDUCTION TIME IN RESPIRATION EXPERIMENT WITH WASHED CELLS OF BACTERIA GROWN IN MEDIA CONTAINING SODIUM LACTATE WITH AND WITHOUT NICOTINIC ACID.

Source of cells	Substances added to system	Time for complete reduction of methylene blue (1:5000)*
Medium + 0.005 γ N. acid	Nic. acid, 10 γ	98 minutes
,, — ,,	,, ,, 10 γ	193 ,,
,, + 0·005 γ N. acid	Nothing	163 ,,
,, — ,,	Nothing	No reduction
,, + 0·005 γ N. acid	Cozymase 0·2 c.c.	50 minutes
,, — ,,	,, 0·2 c.c.	50 minutes

* *M*/20 lactate served as donator.

These data explain some discordant results in the literature[2,3]. It has not previously been suspected that glucose (in the absence of nicotinic acid) inhibits growth ; even 0·01 per cent glucose is sufficient to give this effect. It also appears that in the absence of a fermentable carbon compound minimal amounts of nicotinic acid exert an inhibitive effect on growth.

The results show further that nicotinic acid acts only after it is converted by the cell into an activator (a codehydrase ?), and by making available a simple source of energy it affects a more accelerated and abundant growth. The function of nicotinic acid is, therefore, as a part of cozymase, a function which it probably fills also in the animal body.

I. J. Kligler.
N. Grossowicz.

Department of Hygiene and Bacteriology,
Hebrew University,
Jerusalem.

Sept. 13.

---

[1] Kligler, I. J., and Grossowicz, N., Nature, 142, 76 (1938) ; *J. Bact.*, 38, 309 (1939).

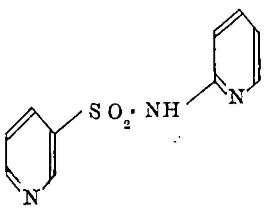
[2] Koser, S. A., Dorfman, A., and Saunders, F., *Proc. Soc. Exper Biol. and Med.*, 38, 311 (1938).

[3] Dorfman, A., Koser, S. A., Reames, H. R., Swingle, K. F., and Saunders, F., *J. Infec. Dis.*, 65, 163 (1939).

Pyridine-3-sulphon-(2-pyridyl)-amide ; a Note on the Modelling of Chemotherapeutic Agents

This compound (I) was prepared for the following reason : pyridine-3-sulphonic acid and its amide were found to inhibit bacterial growth, apparently by interference with nicotinic acid metabolism[1]. Sulphanilamide appears to act as a therapeutic agent by interfering with the utilization of *p*-aminobenzoic acid by the invading organisms[2], but the 2-amino-pyridine derivative (*M. & B.* 693) is in many cases more effective. Following a rule of thumb method common in chemotherapeutic research, the *M. & B.* 693 analogue of pyridine-3-sulphonic acid, (I), was prepared and its inhibitory powers compared with those of the parent acid and amide by *in vitro* tests analogous to those previously described[1,2]. The compound was found less active than the simple acid and amide.

In terms of the theory[3] on the basis of which pyridine-3-sulphonic acid was first investigated, which relates several inhibitory compounds to definite structures (for example, *p*-aminobenzoic acid, nicotinic acid) of importance to the organisms concerned, such failure to produce a more active compound can readily be understood. There is considerable specificity between the mutual effects of *p*-aminobenzoic acid and sulphanilamide, and between nicotinic acid and pyridine-3-sulphonic acid. *M. & B.* 693 is possibly related equally specifically to a derivative of *p*-aminobenzoic acid. Unless, therefore, the natural nicotinic acid derivatives are similar to those of *p*-aminobenzoic acid, it is unlikely that a group which enhances the activity of sulphanilamide will enhance that of pyridine-3-sulphonic acid.



I

Instances of failure to produce more active 'hybrids' in this manner are common in chemotherapeutic literature; for example, among sulphanilamide derivatives themselves, diethylaminoalkyl[4], quinoline[5], tropinone[6] and dihydrocuprein[6] derivatives are described as of relatively little activity, and hybrids between quinine and emetine[7] have not the activity of optimal members of the component series. It is suggested that the reason for such lack of success may be the same as in the case of the present pyridyl compound. Though corresponding essential metabolites are not in these cases known, it is not likely that they will be closely related to one another; known essential metabolites, for example, the vitamins, are very diverse in structure.

Preparation of (I). Pyridine-3-sulphonyl chloride (from 2·5 gm. of the acid) and 2-aminopyridine (1·5 gm.; I am indebted to Dr. A. J. Ewins for this material) were mixed in pyridine (5 ml.), warmed at 100° for ½ hr. and water (20 ml.) added. The product separated on cooling and was recrystallized from alcohol (60 ml.) yielding colourless prisms (1·8 gm.) m.p. 185° (found: C, 50·8; H, 4·0; N, 17·9; S, 13·5 per cent).

Henry McIlwain
(Leverhulme Research Fellow)
Department of Bacterial Chemistry
(Medical Research Council),
Bland Sutton Institute of Pathology,
Middlesex Hospital,
London, W.1.
Oct. 19.

---

[1] McIlwain, H., *Brit. J. Exp. Path.*, 21, 136 (1940).
[2] Woods, D. D., *Brit. J. Exp. Path.*, 21, 74 (1940).
[3] Fildes, P., *Lancet*, i, 955 (1940).
[4] Walker, J., *J. Chem. Soc.*, 686 (1940).
[5] Gray, W. H., *J. Chem. Soc.*, 1202 (1939).
[6] Buttle, G. A. H., Gray, W. H., and Stephenson, D., *Lancet*, i, 1286 (1936).
[7] Clemo, G. R., McIlwain, H., and Morgan, W. McG., *J. Chem. Soc.*, 610 (1936).

An Electron Diffraction Study of the Surface of Magnesium attacked by an Aqueous Chloride Solution

It is well known that magnesium is vigorously corroded by an aqueous chloride solution. However, previous investigations have always been macroscopic, and did not touch the mechanism of the phenomenon directly. The present study by electron diffraction may provide a fuller knowledge of this phenomenon than hitherto.

In the first stage of corrosion by a chloride solution, simultaneously with the evolution of hydrogen gas, the magnesium became covered with a black porous substance, and then the dark-coated surface in turn became coated with a white porous substance. Upon examining both the black and the white substances by the reflection method of electron diffraction, it was found that they are one and the same, consisting of crystals of magnesium hydroxide, $Mg(OH)_2$, and oxide, MgO; the hydroxide, according to the intensity of the diffraction rings, being present in a slightly larger quantity than the oxide.

Now it is known that magnesium is scarcely corroded in water, and it has been suspected that some sort of a protective film must exist on the surface. This surface film was detected by electron diffraction, which revealed the existence of a mixture of the $Mg(OH)_2$ crystals (large amount) and the MgO crystals (moderate amount). Therefore, the Cl^- ion plays the part of a catalyst in the reaction between magnesium and water, producing magnesium hydroxide and oxide. The diffraction rings from the surface substances produced in water are not so sharp as those from the substances produced in a chloride solution; hence the crystal size of the former is smaller than that of the latter. Using the equation for crystal size introduced by M. von Laue in 1926, that for the magnesium hydroxide is about 50 A., while that for the magnesium oxide is about 70 A.

It is a pleasure to acknowledge that this work has been done under the direction of Dr. Ichiro Iitaka.

Shigeto Yamaguchi.
Institute of Physical and Chemical Research,
Tokyo.
Sept. 24.

Blunted Teeth of Lymnæidæ

Examination of the anterior extremity of the radula of Lymnæidæ reveals a few 'blunted' teeth, but there are sometimes thirty to forty rows of worn teeth in an old mollusc, as seen among the late Prof. Gwatkin's material at the Natal Museum.

Older specimens also contain more rows of teeth than immature ones. New rows are added from the nascent posterior border and the number of tricuspid teeth is increased by coalescence of the cusps of marginal teeth.

Invertebrate teeth are more likely to grow than those of vertebrates which have erupted, and shedding of molluscan teeth is a less frequent process than is commonly supposed.

F. Gordon Cawston.
Britannia Buildings,
West Street,
Durban.
Sept. 17.

RESEARCH ITEMS

Ancestral Longevity and the Sex Ratio

Material from family history records in the Department of Biology of the School of Hygiene and Public Health, Johns Hopkins University, has been used by Philip S. Lawrence to answer the question whether the children or grandchildren of long-lived progenitors exhibit on the average a higher male sex ratio than of those dying at a relatively young or average age (*Human Biology*, 12, 3 ; 1940). It would appear that there is a positive association between the mean male sex ratio of children and the longevity of their parents, and further that this is more pronounced for the duration of life of the mothers than for that of the fathers. In the second generation, it is also higher when the grandparents died at advanced ages. Hence it is suggested that, on the average, the most vigorous part of the population produces the highest proportion of male offspring. At the same time, there is no suggestion in the present study that the sex ratio of offspring has any association, positive or negative, with the fertility of the parents. It is quite probable that where either one or both parents were long-lived, they had produced a greater mean number of children and grandchildren than when both were shorter-lived, but beyond the age of productivity. This indicates that individuals that possess the greatest amount of innate constitutional vigour are, by and large, the most highly fertile of the population. Experiments on *Drosophila melanogaster* strongly indicate that the offspring of parents that died at older ages have a higher average male sex ratio than the offspring of parents that died at younger ages. The association is particularly true with respect to the maternal organism. The data fail to show any regular association between fertility and the duration of life of fathers ; but for mothers an increase in longevity was accompanied by an increase in fertility both for production over the entire life-period, and also during particular portions of the life-span.

Evolution of the Mammalian Palate

The detailed investigation to which the skulls of fossil reptiles has been subjected in recent years offers new opportunities for the examination of mammalian homologies. Largely on embryological evidence, the mammalian vomer has been generally regarded as a development of the reptilian parasphenoid, but F. R. Parrington and T. S. Westoll regard the palæontological evidence as indicating the truth of the earlier view that the paired 'pre-vomers' of the reptile fused to form the mammalian vomer (*Phil. Trans. Roy. Soc. Lond.*, B, 230, 305–355 ; 1940). Thus direct fossil evidence shows that the Triassic Theriodonta possessed vomers and palatine processes directly comparable with those of mammals, and that these were developed from the reptilian pre-vomers and premaxillæ respectively. Accordingly, the term 'pre-vomer' is really synonymous with vomer and its use should be discontinued. In the monotremes the 'mammalian pterygoid' and '*Echidna*-pterygoid' are shown to be homologous respectively with the pterygoid and ectopterygoid of the Theriodonts and other reptiles, and in ditrematous mammals the pterygoid includes the homologue of the reptilian pterygoid. In general, in the development of the mammals the snout region and the dentary have been comparatively little modified, but there has been a notable shortening of the post-dentary region, the posterior part of the pterygoids, and the orbitosphenoid, although this shortening does not extend to the roof of the skull.

Nesting Conventions of the Black-headed Gull

It has been stated by F. B. Kirkman that the territory of a black-headed gull (*Larus ridibundus*) has no fixed boundary, but subsequent observation leads him to modify that view (*British Birds*, 35, 100 : 1940). Measurement of the distance between a relatively small number of nests in a single colony showed that the minimum between nesting groups was 1½ ft., except in two cases when the distance was 2 or 3 inches less. Nests were moved closer than the 1½-ft. limit, and as a result of observing the reactions of their possessors towards their neighbours he comes to the conclusion that an 'inner territory' exists "that serves exclusively to determine its space relations with its next neighbours in its nesting group. Next neighbours may be some feet apart, but they must not, as a general rule, be less than 1½ feet". This inner territory is recognized as a prohibited area by the neighbours themselves, since they avoid intruding upon it, at any rate when the owners are present, and its biological value is said to be that, while allowing a certain proximity, it keeps nesting neighbours sufficiently apart to prevent contact and strife. A weakness of the paper lies in its failure to confirm the observations by measurement of the distances between a much greater number of nests and of nests in different colonies. Perhaps the author in further investigations may be able to correlate the reach or striking distance of a black-headed gull with the distance between nests.

New Termite Intercastes

A. M. Adamson has described intercastes of two species of termites (*Proc. Roy. Soc.*, B, **129** ; 1940). It appears that an individual of *Nasutitermes guayanæ* from Trinidad represents the only known termite intercaste combining important features of two castes. The head is soldier-like in most of its features but the compound eyes, ocelli and some other characters are those of the reproductive caste. The pronotum is intermediate between that of the soldier and reproductive castes, while the wing-buds bear resemblance to those of the reproductive nymph but with adult pigmentation of the wings. Two soldiers of *Microcerotermes arboreus*, also from Trinidad, with wing-buds, exceptionally large vestigial eyes and with the pronotum intermediate between those of the soldier and reproductive castes are also described. The significance of these intercastes is discussed, and they lend support to the opinion of A. E. Emerson and others that the worker caste arose phylogenetically from the soldier. The author concludes that the subject of the origin of the intercastes must await further studies on the general problem of caste determination.

Fructosans in the Monocotyledons

A LARGE number of fructose polymers, distinguished from inulin by their great solubility in cold water, have been found in recent years widely distributed in Monocotyledons. These substances form the subject of a useful review, under the above title, in the *New Phytologist* (39, May 1940). Owing to their mucilaginous and non-crystallizable nature, the isolation of these substances as chemical entities has seldom been achieved, and the establishment of their constitution by the methylation technique of Haworth has as yet made little headway. Seasonal changes in fructosan content in such a plant as barley indicate that under normal conditions there is an increase of fructosans in the whole plant until stem elongation is complete. Afterwards the amount of fructosan present diminishes, but it is not clear whether they are utilized in respiration, or synthesis of polysaccharides or proteins. The leaves contain only a small fraction of the total; the bulk is present in the stem and ears where they probably arise from hexoses, the latter themselves produced from the inversion of sucrose, the carbohydrate which is probably translocated to these regions. Seasonal changes in the fructosan content of Iris, Lycoris and Asphodelus suggest a similar storage role; they accumulate during the period of leaf activity, in leaf-base and rhizome, and are partially used up during seed production.

Studies of Meiosis

O. H. FRANKEL (*J. Genetics*, **41**, 419–34; 1940), C. D. Darlington (*J. Genetics*, **41**, 35–48; 1940), C. D. Darlington and L. La Cour (*J. Genetics*, **41**, 49–64; 1940) provide data from Fritillaria, Lilium and Tulipa which sheds some light on the factors governing pairing and chiasma formation. These factors would appear to be the position of the start of pairing, the length of time allowed for pairing to take place and the basic cause of chiasma-formation —believed to be torsion in the paired regions. Frankel shows that pairing starts practically always near the centromere in Fritillaria. A second contact point in the distal region shows its effect if the time allowed for pairing is sufficient. The time allowed for pairing also controls the amount of pairing of the chromosome. Bivalents with median centromeres are delayed in pairing as compared with bivalents with subterminal centromeres, and therefore show various differences in behaviour. It is believed that there is an inverse relationship between the extent of time for pairing and the degree of torsion. The statistical analysis of chiasmata in triploid Fritillaria and in the hybrid *Lilium testaceum* provides further evidence regarding the order of pairing and the ways in which this is interrupted. The higher chiasma frequency per configuration of a triploid is shown to be related to the change of partner and the increased number and distribution of contact points of pairing. Pairing proceeds at a more variable rate, and its average rate is lower in the hybrid *Lilium testaceum* than in the species.

A Chimæra in Sorghum

J. B. SIEGLINGER (*J. Hered.*, **31**, 363–364; 1940) has found a bilateral chimærical plant of Sorghum in the F_5 generation which was segregating for red and white pericarp colour. One half of the panicle contained white seeds which were striped red on the basal portion while the other half of the panicle bore the normal red seeds. The different types of seed produced similar progeny, thus indicating that the embryonic tissue was not influenced by the mutation which gave rise to the striped pericarp.

Interatomic Forces and Helium in Rocks

UNDER this title, N. B. Keevil discusses (*Proc. Amer. Acad. Arts and Sciences*, **73**, 311–359; 1940) the fate of the helium atoms generated in rocks from radioactive elements, with special reference to the factors which might permit some diffusion of helium through rocks during the vast extent of geological time. Consideration of the dimensions of the helium atom and construction of potential energy curves involving helium show that the size is large compared to the structural 'holes' in common minerals. The chance of escape through distortion channels resulting from radioactive decay should be high in radioactive minerals, but small in ordinary rock minerals. Calculations indicate that an opening 1·2 A. wide would have to be formed before escape would be possible. If diffusion were possible through crystal structures the effect would be so extensive during geological time that a uniform concentration of helium throughout a given rock would by now have been attained. Discussion of several factors suggests that migration of helium in ordinary rocks should normally be less than about eight per cent. With imperfections due to strains during crystal growth or subsequent alterations greater losses may be expected. Helium may be expelled completely during recrystallization, but mild thermal metamorphism would appear to have no effect. It is concluded that while 'helium-ages' of rocks are usually considered as minima, this preliminary survey of the problem indicates that ages obtained on carefully selected minerals should not differ from the true values by more than the present experimental errors of measurement.

Polyisobutylene

Brill and Halle, in 1938, showed that when polyisobutylene was stretched the amorphous X-ray diagram was replaced by a fibre pattern analogous to the case of natural rubber. They determined the identity period and concluded that the stretched molecules are not planar zig-zag in shape but because of the methyl side groups are probably helical. C. S. Fuller, C. J. Frosch and N. R. Pape (*J. Amer. Chem. Soc.*, **62**, 1905; 1940) have re-investigated the substance and have generally confirmed these results. The chain molecules in the crystalline regions assume a coiled form and possess a 1 : 3 disposition of the methyl groups. The fibre identity period is found to be 18·63 A. and this is assumed to be the *c* distance of an orthorhombic cell, the *a* and *b* distances being 6·94 A. and 11·96 A. This is based on a very probable molecular scale model, but other models are not absolutely excluded. The one chosen is consistent with the X-ray results; it gives the chain configuration in isobutylene as that of a helix in which the successive methyl group pairs pack together in a staggered arrangement. This requires successive partial rotations of the methyl group pairs at an angle of 45° around the molecular axis, with coincidence after eight rotations. Diagrams of the models are given in the paper. The space symmetry group suggested is identical with that proposed by Meyer and Mark for natural rubber, but later work has modified this in favour of a less symmetrical space group.

WINDOW BREAKAGE BY BOMB-BLAST

THE October number of the *Journal of the Institute of Physics* contains a special article by Dr. H. Moore, director of research for Pilkington Brothers at St. Helens, dealing with some physical problems of war-time window breakage. The effects of bomb-blast were studied experimentally by using small 2-lb. charges of blasting powder exploded under suitable conditions. Instantaneous photography of 7-ft. square ½-in. plate glass windows showed that typically, under blast, the damage occurs in two stages. In the first, during the compression period the centre of the glass is forced inwards as a diaphragm, and ring and radial cracks develop. In the second stage, before the pieces have time to separate, the 'suction' half of the wave comes into effect and the pieces fall towards the bomb. If the glass is very near to the bomb so that all the air is displaced by the gases from the explosive, the broken pieces are driven away from the bomb. Short of blocking up a window with brickwork or enclosing it in shutters of heavy timber or stout steel it is practically impossible to safeguard the glass against fracture.

Attention was therefore directed to studying methods of preventing personal injury from flying fragments of glass. Consistent with previous results, sheets of transparent cellulose or fabric are effective if firmly fixed to the glass and carried well over and securely fixed to the edges of the window frame. Complete coverings are always better than separate strips of the same materials. The adhesive must be chosen with care, but ordinary flour paste as used by paperhangers may be used with reasonable safety. Although sodium silicate or water-glass gives excellent adhesion the glass will be etched and left permanently 'greyed'. Toughened glass and panes reinforced internally with wire mesh stood up well to the effects of blast.

Unless the explosion is very near to the window, glass fragments due to blast usually burst outwards. Fragments of glass, debris or bomb casing may, however, still be thrown inwards. Some protection from these is secured by 'lengthening the time of the blow'. For this purpose leaded panes, thick curtains, two or three thicknesses of hessian or ½-in. wire netting stretched on wooden frames and hanging freely some 3–6 in. from the glass have all proved effective.

In the same article the problem of blacking-out roof lights is briefly discussed. One solution was the use of coloured sources of artificial light emitting only a restricted range of the visible spectrum. The windows and roof-lights were then painted with a varnish transmitting only the complementary visible range. When workers found difficulty in getting accustomed to the coloured lighting, the quick and cheap method of painting the glass with black paint was widely adopted. Reasoning showed that windows exposed to strong sunlight might crack unless they were painted upon the outside—or upon the inside, according to the argument used. Observation showed that the windows were liable to crack in strong sunlight, on whichever side of the glass the paint was put. A study of the conditions showed that cracking was due to temperature differences between different regions of the glass sheet, and not to differences of temperature through the thickness. Cracking was avoided when all parts of the glass, and particularly the edges, were exposed to the radiation in the same way as the centre and if the edges were constrained no more rigidly than in the ordinary fixing with putty.

INDIAN FISHES OF ECONOMIC VALUE

SEVERAL interesting papers on Indian fishes are included in recent numbers of the *Records of the Indian Museum*. The most important of these are two on the Indian shad ("On Some Early Stages in the Development of the so-called Indian Shad", *Hilsa ilisha* (Hamilton) by K. Krishnan Nair[1] and "Further Observations on the Bionomics and Fishery of the Indian Shad", *Hilsa ilisha* (Hamilton), in Bengal waters by Sunder Lal Hora and K. K. Nair[1]). Hilsa is a clupeoid, closely related to the herring, and forms an important fishery. It breeds in the river throughout the year, and the two breeding peaks, large and small, are shown to be correlated with the flooding of the river owing to the monsoon and the nor'westers respectively. The young migrate down the river, and the upstream migration on which the main fishery depends is attributed to the monsoon and the state of maturity of the migrating individuals. A brief account is given of fluctuations in the year-to-year Hilsa fishery, and it is surmised that a five-year cycle exists in the fishery of this species. Hilsa can flourish well in confined fresh waters and even attain maturity. From the discovery of a regular fishery of young Hilsa in cold weather near Calcutta it has been suggested that more attention should be paid to the conservation of the Hilsa fisheries rather than to the establishment of hatcheries for the artificial rearing of the fish.

The collection and hatching of the eggs continues as a routine at Madras and, in Calcutta, owing to the continuation of biological investigations at the Pulta Waterworks by the Zoological Survey of India, a considerable amount of information on the bionomics of this fish has been collected. It was from this latter material that Nair made his observations on the larval forms, giving special attention to the number of vertebræ and changes in the relative proportions of the fish during growth.

T. J. Job ("On the Breeding and Development of Indian 'Mosquito-fish' of the genera *Aplocheilus* McClelland and *Oryzias* Jordan and Snyder"[2]) has investigated the life-histories of those fishes which are commonly used as mosquito controls. The genus Aplocheilus is the most important, and the breeding of three species of these is described; also that of *Oryzias melastigma*. The so-called 'killifishes' have been found to be of immense value in the biological control of mosquitoes. These researches are important and very interesting. The development of Aplocheilus is rapid, and metamorphosis takes place in about three weeks after hatching; from this stage onwards mosquito larvæ are eaten. The eggs of all the species of this genus are laid separately and are attached by threads to weeds. In Oryzias the female carries her eggs in clusters, in some species throwing them off so that they become entangled in weeds. Thus there is a certain amount of parental care, and in *O. melastigma* they may or may not be carried until hatched. This species stays long in the larval state, and it may be one and a half months old before feeding on mosquito larvæ.

All these studies of life-histories are valuable, and it is hoped that more may be done on similar lines.

[1] *Rec. Indian Mus.*, 41, Part 4 (1939).

[2] *Rec. Indian Mus.*, 42, Part 1 (1940).

THE INORGANIC ELEMENTS IN NUTRITION

EXTENSIVE investigations made within recent years and demonstrating the importance to human nutrition of minute quantities of various mineral elements were reviewed by Prof. E. V. McCollum, professor of biochemistry in the Johns Hopkins University School of Hygiene and Public Health, in a paper read at the University of Pennsylvania Bicentennial Conference on September 17.

The early literature of nutritional research placed emphasis almost entirely on proteins, carbohydrates and fats, and gave little attention to the inorganic nutrients, in spite of the fact that Liebig, about 1830, had shown the importance of minerals as fertilizers for the growth of plants. However, it must have been dimly appreciated that, since the bones contain so much calcium phosphate, an adequate supply of these elements must be provided for growing creatures. The appetite for common salt was accepted as evidence for the need of sodium and chlorine. Isolation of hæmoglobin by Hoppe-Seyler in 1862 stimulated investigations of the role of iron in the body, and during the last quarter of the nineteenth century physiologists studied some of the fundamental problems relating to the physiological action of salt solutions, including the development by Ringer of his famous solution. By the beginning of the twentieth century research in the mineral elements of nutrition had made much progress, and it is now known that at least thirteen inorganic elements are concerned with biochemical processes and must be provided in adequate amounts in the diet.

More than thirty years ago Dr. H. C. Sherman, of Columbia University, showed that calcium is one of the elements in which the human diet is frequently deficient. Milk and leafy vegetables are the only foods commonly eaten by man which are rich in calcium, and the rather poor utilization of the calcium of several green vegetables is due to their high content of oxalic acid, which interferes with calcium absorption. The calcium problem in human nutrition was intensified by the perfection of milling machinery so that all the mineral-rich parts of the grain could be removed from the part which is sold as flour, and to the rise during the last century and a half of the consumption of sugar, which now stands at an average of more than one hundred pounds per capita per annum. The large fraction of the total food supply taken in the form of refined cereals and sugar, the latter entirely free from mineral elements, puts upon the remaining portion of the diet the burden of supplying almost the entire inorganic needs of the body.

The effects of calcium deficiency range from a decreased rate, or cessation of growth, to premature death. Many of the effects are due to the shortage of this element in the blood, which normally contains only 1 per cent or less, of all the calcium in the body, 99 per cent being in the bones and teeth.

Prof. McCollum referred briefly to the researches conducted around 1922 which showed that lack of vitamin D was a principal cause of rickets, a disease in which there is poor development of bones and teeth. Previous to 1922, the cause of rickets was unknown, although the disease had afflicted millions of infants and children in temperate regions throughout the world during many hundreds of years. Simply supplying calcium and phosphorus, the main ingredients of bone, was not sufficient. These minerals could not be built into bone, it was then found, without the assistance of vitamin D. It was Prof. McCollum and his associates who demonstrated this fundamental fact by noting that the sudden introduction of cod liver oil into the diet of a rat with rickets was followed by deposition of lime salts in the bone. The freshly deposited lime showed in the X-ray as a distinct line across the head of the bone, and became a test of the curative effects in treating rickets. It was later shown by a number of research workers that sunlight on the body or artificial irradiation of foods caused the formation of vitamin D in the body or foods and prevented or corrected rickets in children.

Next to the nutritional problems traceable to deficiencies of calcium and phosphorus and vitamin D (and these are now in great measure being prevented), anæmia due to deficiency of iron is perhaps the most widespread inorganic nutritional problem. Apparently about 50 per cent of the iron in cereal grains and certain other common goods is in the so-called 'hæmatin' form, in which it is not available for assimilation by man or animals. It has been noted that the utilization of iron by the system is impaired when the supply of ascorbic acid (vitamin C) in the diet is inadequate, and there are reports that anæmic persons on a low iron diet show a marked response in the number of red blood cells and the hæmoglobin percentage when ascorbic acid is given to them. Also iron tonics in certain cases have led to no improvement in the blood until fresh fruits or raw vegetables which are good sources of vitamin C are included in the diet. Prof. McCollum remarked that preventable or curable anæmia is so widespread and so common that these newer observations on the manner of assimilating iron are of great practical significance.

It has been shown also that copper is important in connexion with the utilization of iron, and that copper deficiency is fairly widespread among infants.

One of the most interesting mineral elements, in its behaviour in the animal body, is manganese. Rats given a diet deficient in manganese were unable to suckle their young, and they showed no normal maternal instincts. Many of the neglected young rats died within a few hours. Deficiency of manganese in chickens produces a condition known as 'slipped tendon', or perosis, in which the angle joint is displaced and the birds crippled so badly they usually die. Hens deficient in manganese lay eggs of very low hatchability, many of the chicks dying in the shell a few days before the time for hatching. These embryos are often deformed, having short, thickened leg and wing bones and globular heads. When manganese is injected into hens deficient in the mineral the eggs hatch normally and produce chicks with normal bones. At present there is no evidence concerning the occurrence of manganese deficiency in human beings.

Reference was also made by Prof. McCollum to the demonstration of cobalt deficiency as the cause of a blood disease in sheep and cattle known variously throughout the world as 'Denmark disease', 'coast disease', the 'pines', 'bush sickness', and 'salt sick'. The animals suffering from the disease were found to have been grazing on pastures the soil of which was deficient in cobalt. The investigations which proved the point constitute one of the classics of nutritional research. This disease, it will be recalled, has been the topic of articles and correspondence in NATURE during recent years.

AFFINITIES IN THE PUEBLO CULTURE OF ARIZONA*

DR. FRANK H. H. ROBERTS, JUN., continues his report on his archæological excavations of the Whitewater Anasazi or Basket-Maker-Pueblo remains in Eastern Arizona (see NATURE, 144, 556; 1939) by an account of the pottery, and objects of bone, stone and shell which were found, as well as of the burials which were examined. From the burials skeletal remains of 150 individuals were discovered, but of these 15 only were sufficiently well preserved to permit of recovery, examination and report.

The objects recovered by the investigation permit of a very partial view only of the material culture of the inhabitants. Virtually the whole of the products of their industry made of perishable material is missing. A few potsherds bear the impress of basketry, while a few charred pieces of cord were found. The basketry was of the characteristic coiled form. There is no evidence of clothing, textiles or wooden implements, though these must have played a large part in their lives.

The specimens collected were found in the remains of houses, in the various refuse mounds, as offerings accompanying burials, in a few instances on the old occupation surface near dwellings and outside fire-pits. No articles appear to have been made specially for funerary purposes.

Most of the artefacts represent one stage, the Developmental Pueblo, though there are a few from the earlier stage, the Modified Basket-Maker, and the later, the Great Pueblo. Dated timbers from the various structures indicate datings ranging from the early part of the ninth century to the early years of the eleventh century A.D. Pottery sequences have been checked and confirmed by stratigraphic evidence.

True pottery first appears in the Anasazi province in the Modified Basket-Maker stage. Vessels were occasionally made of unfired clay tempered with shredded cedar bark or grass, the prototype of the later makes that came to play so prominent a part in the life and industry of the people. In some instances the bottoms were moulded in baskets, the walls or rims being formed of fillets of clay looped around the upper edges. Others were fashioned entirely by hand without basal support by a coiling process. The principal shapes were shallow trays and deep bowls. The unfired clay objects may be attributed to influences from regions to the south but the methods used seem to have been mainly indigenous, since the Basket-Makers were already adepts in the use of clay for architectural purposes, as for example in the jug-like necks of the tops of their granaries and the mud steps placed on granary walls. When firing of clay developed, the cedar bark binder was replaced by sand, which in turn was gradually replaced by powdered rock, and this in the Developmental Pueblo period by ground potsherds.

The Modified Basket-Maker phase had developed a variety of shapes in its pottery, while protruding particles in the paste gave it a characteristic irregularly stippled appearance. Decoration for the most part was confined to the interior of bowls and was produced by the use of carbon which was prevalent in north-eastern Arizona, and an iron, which was widely distributed over the remainder of the area. The designs are generally ribbon-like panels embellished with dots, zig-zags, and stepped line elements. The opening of the Developmental Pueblo period witnessed changes. New features were introduced and there was a marked expansion in the industry. Surfaces were carefully smoothed and the application of a step was introduced. A great diversity of form is shown with colour; plain grey, black on white, black on red, and brown with a brownish exterior and a slightly burnished interior. All types of vessel are decorated. There are two main groups of the light-coloured vessels ornamented with black, of which one occurs throughout the eastern part of Arizona centring about the Chaco Canyon area, and the other predominating in the west.

On the Whitewater site, stratigraphic tests show a definite progression in pottery forms and a certain sequence in the appearance of types. This is augmented by the association between ceramic styles and house remains and an indication of a certain

---

[*] Smithsonian Institution, Bureau of American Ethnology, *Bull.* 126. Archæological Remains in the Whitewater District, Eastern Arizona. Pt. 2. Artifacts and Burials. By Frank H. H. Roberts, Jr. With an appendix: Skeletal Remains from the Whitewater District, Eastern Arizona. By T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: G.P.O.) 50 cents.

time factor through the dendrochronological dating of some of the structures. The earliest type of pottery noted for the district is a form identifiable as late Modified Basket-Maker of the eastern variety—a type occurring across the plateau in western New Mexico to the San Juan and into the north-eastern San Juan basin. The second type in the series is one typical of the beginning stage of the Developmental Pueblo period through the greater part of the Anasazi province that was characterized by the Chaco cultural pattern. Afterwards, a new form appeared that gives strong evidence of Chaco influence but which seemingly comes from the area lying between the Puerco and Little Colorado Rivers—the Little Colorado style as it has been called. While this ware indicates an affinity with types found along the Little Colorado, the designs suggest a Chaco derivation. A third type of the Early Developmental Pueblo is the Kana—a black on white. Most of the ceramic developments during middle and late phases of the Whitewater occupation were an outgrowth from these three forms with some additions from the Little Colorado, the Upper Gila of New Mexico, and continued influence from the Chaco Canyon area in north-western New Mexico.

The significant feature about the pottery evidence is that it demonstrates an early south-west extension of influence from the Chaco Canyon area with a spread later toward the north-west from Little Colorado centres and towards the south-east from the Kayenta or Tusayan region—a movement contrary to that postulated by many south-western workers and tending to show that many traits appear in the Chaco that have been attributed to influence penetrating from the Little Colorado region, though they belong to the Chaco and were diffused from there towards the Little Colorado. Further, from evidence of the present material, there must have been a strong interplay of influence between the Chaco and Tularosa regions before the growth of that between Tularosa and Little Colorado.

Although the skeletal material examined by Dr. Stewart is not sufficient to give a broad view of the general characteristics of the people, certain interesting and important points emerge.

In the first place, further elaboration is given to Seltzer's view that the evidence does not justify the theory of a sweeping change in physical type during the transitional Basket-Maker-Pueblo period. This theory rests chiefly upon the unproved premise that cranial deformation among the Pueblos is accidental, but the predominance of lambdoid deformation in the Whitewater District and among the culturally related groups in New Mexico and Colorado lends force to the view that in general its use among the Pueblos was more than accidental, thus effectively masking the long-headed form of the natural skull. The evidence thus runs contrary to the generally accepted view that the beginning of the Pueblo period was marked by an infiltration of round-headed groups.

Secondly, the present group shows definite relationship to the Basket-Maker physical type as well as to other peoples having the Anasazi cultural pattern, the so-called "South West Plateau" physical type. Further, according to Dr. Stewart the 'lambdoid' type of deformation points to a relationship with peoples who occupied certain sites in the Chaco Canyon and south-western Colorado, "a feature which correlates nicely with the cultural evidence for a predominant Chaco influence in the [Whitewater] arts and industries".

FORTHCOMING EVENTS

Monday, November 18

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 1).

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Miss Harriet Wanklyn: "The Rôle of Peasant Hungary in Europe".

Tuesday, November 19

Institution of Civil Engineers (at Great George Street, S.W.1), at 1.30 p.m.—Mr. William Barnes: "Methods of Excavation Work at Home and Abroad" (Dugald Clerk Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Head of the Engineering Department of the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (November 21).

Engineering Workshop Instructor—The Principal, Twickenham Technical College, Egerton Road, Twickenham (November 23).

Assistant Mechanical Engineer for the Electrical Branch, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9346).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Technical Report, Reference W/T2: A Critical Study of the Application of Electricity to Agriculture and Horticulture. By C. A. Cameron Brown. Pp. 84. (London: British Electrical and Allied Industries Research Association.) 2*s*. net. [3010

London Shellac Research Bureau. Bulletin No. 4: Chemical Constants of Lac—Some Notes on the Acid, Saponification and Hydroxyl Values of Lac. By Dr. B. S. Gidvani and Mrs. J. M. Dobbie. Pp. 16. (London: London Shellac Research Bureau.) [411

Other Countries

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1940. Pp. 8. (Salisbury: Queen Victoria Memorial.) [2210

Colony and Protectorate of Kenya. Forest Department Annual Report, 1939. Pp. 30. (Nairobi: Government Printer.) 2*s*. [2210

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 19, 1937. iv. Meteorologiska iakttagelser i Sverige, Band 79. Pp. xi+107. 7 kr. Årsbok, 21, 1939. i. Månadsöversikt över väderlek och vattentillgång. Pp. 78. 2.50 kr. Meddelanden, Band 7, No. 6: Temperaturmätningar i Vänern och Götaälv. Av Anders Ångström och Stig Jacobson. Pp. 20+12 plates. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [2310

Smithsonian Institution: Bureau of American Ethnology. Bulletin 126: Archæological Remains in the Whitewater District, Eastern Arizona. Part 2: Artifacts and Burials. By Frank H. H. Roberts, Jr.; with an Appendix: Skeletal Remains from the Whitewater District, Eastern Arizona, by T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: Government Printing Office.) 50 cents. [2510

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 391: The Utilization of Certain Feeding Stuffs by Cattle. By E. B. Forbes, John W. Bratzler and Cyrus E. French. Pp. ii+14. (State College, Pa.: Pennsylvania State College.) [2910

Proceedings of the American Philosophical Society. Vol. 83, No. 4: Symposium on Characteristics of American Culture and its Place in General Culture. Pp. 513–588. (Philadelphia: American Philosophical Society.) 50 cents. [2910

Proceedings of the United States National Museum. Vol. 89, No. 3094: The West American *Haliotis*. By Paul Bartsch. Pp. 49–58+plates 6–8. (Washington, D.C.: Government Printing Office.) [2910

Royal Observatory, Hong Kong. Meteorological Results, 1939, prepared under the direction of C. W. Jeffries. Pp. v+144+40+6. 3 dollars. Annual Report of the Director of the Royal Observatory, Hong Kong, for the Year 1939. Pp. F8. 30 cents. (Hong Kong: Government Printers.) [2910

Report of the Kodaikanal Observatory for the Year 1939. Pp. 6. (Delhi: Manager of Publications.) 2 annas; 3*d*. [111

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 23, 1940 No. 3708

THE MINISTRY OF WORKS AND BUILDINGS

IN his speech to the Trades Union Congress on October 9, Mr. Ernest Bevin stated that the Cabinet had decided against the establishment of a Ministry of Reconstruction to consider the problems of the peace and to prepare plans for meeting them. Instead, a Cabinet committee has been set up to consider post-War questions and to work out general principles for guidance. There will be many who think that Mr. Bevin did less than justice to the work of the Ministry of Reconstruction established under Dr. (now Lord) Addison in 1917. Whether we hold that the task of preparing for the future should be the task of a special Ministry of Reconstruction or, as suggested by Prof. J. H. Jones, of an Economic Reconstruction Commission, the task is clearly that of the Cabinet, and the gravest danger to be avoided is that of hasty improvisation by war-weary Ministers in control of departments that have been overburdened by the urgent tasks imposed by the War.

The appointment of Lord Reith to the new office of Minister of Works and Buildings and First Commissioner of Works is, however, indication that the Government recognizes more fully than Mr. Bevin's speech would imply the magnitude of the task which lies ahead. The general approval with which the creation of this new office was received may indeed be attributed to the assumption that its task was to be almost wholly that of reconstruction—immediate and local in bombed areas, theoretical and general as regards national replanning and rebuilding after the War. These expectations were somewhat disappointed by Mr. Attlee's statement on October 24 regarding the functions of the new Ministry, and by Lord Reith's own statement in similar terms on November 13 in the House of Lords. Wide as are the functions of the new Ministry, they do not inspire the vision of a new England of well-designed, clean and slumless towns, an architecture of public buildings and private homes justifying civic and personal pride, the wise and creative use of the new materials and the planning of communications and industrial and other building to safeguard æsthetic and health values as well as serve efficiency.

The two statements were largely confined to the war-time duties of the Ministry and the alterations in departmental responsibilities. The new Ministry will be responsible for the erection of all new civil works and buildings required by any other Government department. It will take over the whole organization of His Majesty's Office of Works, including its present responsibilities for the erection of buildings for other civil departments and for service departments, and some of the work of the Ministry of Supply, including the new buildings section of the Ordnance Factories and the approval of plans of new private factories or the extensions of existing private factories to the cost of which the Ministry of Supply is contributing. The Ministry will be responsible for the licensing of private building, and for determining the priority of proposals for rebuilding buildings damaged by air raids. By arrangement with the service departments or the Ministry of Aircraft Production it may erect on their behalf new works and buildings not of a highly specialized character, or supervise contracts for the erection of new private factories or the extension of existing private factories required for war production.

The general order of priority of building work will be laid down by the Production Council, of which the Minister will be a member, and he will be responsible for the Works and Buildings Priority

Committee. The Minister will be empowered to call for information from all departments retaining responsibility for the erection and maintenance of buildings and works of construction, including departments concerned with work carried out by or for local authorities and public utility undertakings. He will also be responsible for such control, or central purchase of building materials not at present controlled, as may be necessary. The Minister will also have the task of instituting research into such questions as the adoption of substitutes for building materials which are in short supply, or the modification of designs and specifications with a view to expedition and for ensuring that the results of past and future research are promptly communicated to all concerned. For this purpose he will make full use of the building research organization of the Department of Scientific and Industrial Research. He will be empowered to call on Departments retaining responsibility for building to satisfy him that they were making full use of the results of research in this connexion.

This statement shows that the Ministry of Works and Buildings clearly envisages the great possibilities open to the building industry, architects and town-planners ; first, the control by a single authority of the production and allocation of all building resources for the period of the War ; secondly, the continuance of the Ministry's control after the War so that building resources may be carefully guided in supplying a huge demand ; and thirdly, the post-War amalgamation of the Ministry and the Town-Planning Section of the Ministry of Health to evolve and direct positive territorial planning policy. Even should the first of these functions absorb all the energies of the Ministry for the first year, if its powers are exercised with wisdom and foresight, many undesirable developments may be checked and much important preparatory work for reconstruction completed.

The Ministry of Works and Buildings is clearly the only right remedy for the serious difficulties which have arisen from the shortage of certain materials, plant, etc., and the even bigger difficulties in the production of building materials of the required kinds and their allocation between war expansion requirements, air raid repairs to communications, services and essential buildings, general works of maintenance, civil defence works and such other works as are made necessary by bombing. Its duties as outlined by Lord Reith falling into the three divisions, supervision, execution and research, provide the essential co-ordination of resources and should secure the full cooperation of the industries concerned.

An important memorandum recently forwarded by the Garden Cities and Town Planning Association to the Prime Minister and other ministers concerned with the use of land, outlining a practical policy with regard to bombed-out factories, rebuilding and replanning damaged areas, housing, compensation and the preservation of land for food-growing, urges that the control of war-time developments of industry or rehousing exercised by the Ministry should be through a fully qualified planning board, competent to consider and to balance all the national interests that arise in new developments. The present situation indeed stresses the importance of the principles and recommendations of the Barlow Commission, and adoption of the principle of long-range planning by the Government is a first consideration even from the point of view of the building industry alone. Indeed only by insisting on the duty of forecasting, by programmes obtained from all other departments, the total demand on the building industry at least a year ahead and preparing resources to meet those demands in the light of probable shortages of important materials, can the Ministry hope to discharge its most immediate task.

Beyond those immediate problems there must be kept in mind those broad principles which have emerged from inquiries into the distribution of the industrial population in recent years. To limit the size and density of cities, to move out congested industries to moderate-sized well-planned towns, including some new garden cities ; and to replan and rebuild the central parts of old cities, with much more open and garden space and more attention to convenience and beauty, and the elimination of wasteful daily travel so far as possible—these are now practical objectives the achievement of which is even assisted by the destruction already caused by air attack.

The new Ministry may indeed offer us the first prospect of the co-ordination leading to a comprehensive far-sighted national plan of development. Mr. Attlee's statement showed that the Government is alive to the great opportunities which are offered in the reconstruction of town and country after the War. The Minister has been charged with the responsibility of consulting the departments and organizations concerned, with the view of reporting to the Cabinet the appropriate methods and machinery for dealing with the issues involved. The relation of the Ministry of Works and Buildings to the existing machinery for statutory planning must obviously be very close. Accordingly the memorandum from the Garden Cities and Town Planning Association suggests that the best solution of the administrative problem will ultimately be the creation of a Ministry of Planning (or of Planning and Building), to absorb the functions of controlling building and of directing the statutory planning machinery, and to formulate a broad national policy for the distribution of industry which would be operated through the regional and local committees.

The memorandum also submits that the National Advisory Planning Board should consider which of the areas now subject to heavy bombardment are in themselves reasonably satisfactory from a planning point of view and not unduly congested, and which of them are so badly planned or so congested that replanning is advisable. In the former areas there should be no ban on rebuilding or repair at the earliest safe moment, subject to local architectural and planning control and given the necessity of accommodation locally and the approval of the Ministry of Works and Buildings from the point of view of the availability of materials and labour. In the unsatisfactory areas, however, it is strongly urged that wholesale expenditure on restoration or rebuilding should be deferred and the population evacuated to other areas, including those where new factories are being erected. Sir Charles Bressey, whose report on London's transport deserves fresh attention, has independently also entered a plea that no schemes of rehabilitation in bombed areas should go forward without reference to accepted principles and standards for the improvement of London's streets and buildings.

The complexities and possibilities of the problems confronting the new Ministry are indeed immense. They involve the question of evacuation, which, in respect of mothers and young children, is largely a question of the provision of suitable accommodation in the reception areas, part at least of which will involve new construction or the structural adaptation of existing premises. There is also the question of providing alternative accommodation of industries which may need to be dispersed from London and certain other large cities if the destruction of property and dislocation of transport and other public services becomes acute. This involves not merely the provision of a reserve of new factories in suitable situations but also the provision of housing accommodation for industrial workers engaged on war production or the service of the civil population, possibly involving a priority system in the smaller towns.

Moreover, not even in war-time can we neglect the control of building in agricultural areas. Sporadic or ill-considered building has already robbed the country of valuable agricultural land when alternative siting on land less valuable for food production could readily have been found. The criticism of the Select Committee on the neglect of camouflage possibilities in choosing sites could equally apply to neglect of agricultural or food production values. Moreover, some of the worst offenders have been the service departments over whose activities in respect of aerodromes, fortifications and other highly specialized work the Ministry of Works and Buildings will have no control.

Nor is it only on these grounds that there are well-founded fears as to whether the functions and powers of the new Ministry are sufficiently extensive. The work of rebuilding is indeed only a small part of the task of reconstruction awaiting us. That reconstruction will reshape many ways of life and will attack poverty and slumdom, ignorance and ill-health, the insecurities of employment, the closed doors of opportunity. It involves nothing less than the replanning of the national life, and if the Ministry of Works and Buildings is to have any real powers in planning and reconstruction, it must take over much of the present work of the Ministry of Health—especially its housing and planning departments. Besides close relations with the local authorities and with all the technical and professional bodies connected with building, the new Ministry must undertake a large task of education.

We can only hope to build a better order in any sense of the word in so far as both the population and their leaders are prepared for it. Educational work of this type is essential if our younger architects with vision and understanding are to be given the opportunity to express the possibilities of the new materials and to seize the new opportunities of serving social needs. It is equally a preliminary to securing the firm direction from the top to override anarchic interests. If the execution of such a programme of education lies outside the scope of the new Ministry, something at least of the inspiration is to be looked for from it.

RECENT BRITISH EXCAVATIONS IN EGYPT

Temples of Armant

A Preliminary Survey. By Sir Robert Mond and Oliver H. Myers; with Chapters by M. S. Drower, D. B. Harden, S. A. Huzayyin, R. E. McEuen and Mary I. C. Myers. The Text. Pp. xii + 223. The Plates. Pp. vi + 107 plates. (London: Egypt Exploration Society, 1940.)

EGYPTOLOGY is deeply indebted to Lady Mond for making financially possible the publication in these two fine volumes of the material obtained during the excavation of the temple sites at Armant. Much of this material is of considerable archæological and historical importance, and at the same time it comprises inscriptions, reliefs and statues, which, though for the most part fragmentary, will interest both philologists and students of Egyptian art and religion.

In the opening chapter, Mr. Myers deals with the long history of Armant, which as late as the thirteenth century A.D. was still a town of considerable size and importance. It is disappointing to have to record that with the destruction of the late Roman wall in the middle of the last century "have probably gone the last hopes of tracing the life history (as opposed to the funerary record) of Buchis" (p. 10).

A number of fragments of reliefs, once adorning the Eleventh Dynasty temple of Mentu, have been recovered (Pls. XCIV ff.). As examples of Eleventh Dynasty sculpture, several of these fragments are of great value and interest, showing as they do that some at least of the craftsmen of this period were as accomplished masters of technique and design as their predecessors in the Old Kingdom.

It might here be noted that an inscription accompanying one of the Twelfth Dynasty reliefs which Mr. Myers has unearthed suggests that the cult of the Bull of Mentu originated in the town of eṭ-Ṭūd (Pl. XCIX, 2; p. 157).

I am inclined to agree with the suggestion that the Osirid statues bearing the name of Merenptaḥ, who seems to have had some special connexion with Armant, are of Eleventh Dynasty workmanship usurped by the above-mentioned Pharaoh (Pls. XV ff.; p. 50). I find it difficult to believe, however, that the pylon relief of the procession of tribute-bearing negroes headed by a captive rhinoceros dates from the reign of Tuthmosis III (pp. 25 f.). Not only its style but also the phraseology of the accompanying inscription, and above all the occurrence of the word *Pr-ʿꜣ* with the meaning 'Pharaoh'—a usage not so far known before the reign of Akhenaten (p. 160)—suggest the reign of Rameses II. Mr. J. Fisher, by the way, contributes an interesting note (p. 204) on the dimensions of the captive rhinoceros which are inscribed beside the representation of it.

An exceptionally fine example of Egyptian sculpture is the fragment of a relief displaying the heads of captive Nubians and negroes (Pl. LXXXVII, 3). The account of the measures taken to preserve the colouring of this relief is most instructive (p. 23).

Archæologists will welcome Mr. S. A. Huzayyin's chapter on the flint implements (pp. 66 ff.) and will no doubt note with approval his remarks on the possibility of the survival of certain elements and aspects of Predynastic technique into historic times. A similar view was expressed by Dr. G. A. Reisner to me so long ago as 1908.

Mr. Myers deals admirably and at length with the Roman and Coptic pottery, material at one time shamefully neglected by Egyptologists (pp. 78 ff.). Pls. LIV ff. supply a valuable addition to the Corpus of Graeco-Roman-Coptic pottery in "Bucheum III", as do the two coloured plates LXXII and LXXIII, reproduced from paintings by Mrs. Myers, which exemplify the decorations on late Roman and Coptic ceramics.

Miss Drower's chapter on the inscriptions (pp. 157 ff.) deserves a special word of praise. Her translations and notes are admirable, and what she has to say on Mentu and the Hermonthite triad will be read with interest by students of Egyptian religious cults. She is particularly to be congratulated on the way in which she has tackled the important historical text inscribed on the fine, but unfortunately much broken, granite stela of Tuthmosis III. The text in question contains much matter of philological interest, including the Egyptian name for a rhinoceros—*Šꜣḳb*.

The objects in glass, metal, wood and ivory, etc., and the beads, scarabs and amulets, are all dealt with in detail by specialists, from whose comments, as from the various registers and technical reports, much useful information is to be derived.

The photographic and other plates are excellent, clear and not overcrowded, and the indexing, without which a work of this sort loses much of its usefulness, is very thorough. Mr. Myers is indeed to be congratulated on what he has succeeded in accomplishing in these abnormal times.

A. M. BLACKMAN.

TEXT-BOOKS OF ADVANCED MATHEMATICS

(1) Determinants and Matrices
By Dr. A. C. Aitken. Pp. vii+136.

(2) Theory of Equations
By Prof. H. W. Turnbull. Pp. xii+152.

(3) Integration
By Dr. R. P. Gillespie. Pp. viii+126.

(4) Vector Methods: Applied to Differential Geometry, Mechanics and Potential Theory
By Dr. D. E. Rutherford. Pp. viii+128.

(5) Integration of Ordinary Differential Equations
By Dr. E. L. Ince. Pp. viii+148.
(Edinburgh and London: Oliver and Boyd, 1939.) 4*s.* 6*d.* net each.

(6) Advanced Algebra
By S. Barnard and J. M. Child. Pp. x+280. (London: Macmillan and Co., Ltd., 1939.) 16*s.*

THE volumes published under the series title "University Mathematical Texts" mark a new venture in the production of English mathematical text-books. Each of these volumes deals with a single topic, the material of which could be reasonably covered in a one-term lecture course. If the further volumes which are promised maintain the standard of excellence shown by some of those under review, the success of the series ought to be assured.

(1) It is perhaps a sign of the trend of present-day mathematical thought that two of the volumes already issued deal with algebra. The theory of matrices has recently assumed a central place in mathematics. Dr. Aitken's book develops the theory from the beginning, and covers practically all the essential parts of the subject; it commences with a chapter on the algebra of matrices, and then proceeds to define determinants and develop their properties, and to discuss the theory of linear equations and linear dependence. There follows a discussion of the Cauchy and Lagrange expansions of a determinant, the theorems of Jacobi and Binet-Cauchy and their consequences, and finally a chapter on determinants of special type.

The treatment of the subject is masterly, and this work must rank as one of the best text-books on the subject in the language. It should appeal particularly to those students who find the subject difficult at a first reading. The book is well supplied with examples, which serve to clinch the theorems proved in the text, and contain many other results of importance.

(2) The subject matter of Prof. Turnbull's book is of a very different nature, for the theory of equations is one of the oldest branches of higher algebra. Prof. Turnbull's delightful account will be read with interest not only for its excellent treatment of the theory, but also for its interesting historical remarks.

After introductory chapters dealing with polynomials and rational functions, a sketch is given of Gauss's proof of the fundamental theorem of algebra, and this is followed by an account of the theory of symmetric functions. Next follows a chapter on the numerical solution of algebraic equations, and this is succeeded by an account of Descartes's rule of signs and Sturm's theorem. The remaining chapters deal with the binomial equation, cubic and quartic equations (with an introduction to canonical forms) and a brief account of the theory of elimination. The book is most attractively written, and should meet with well-deserved success.

(3) Dr. Gillespie's book on integration seems to be less happily conceived, and it is not quite clear for whom it is intended. The first part deals with the formal technique of evaluation and transformation of simple and double integrals, and with the theorems of Green and Stokes, based on an intuitive definition of a definite integral as an area, while the latter part deals with the rigorous theory of the Riemann simple and double integrals, and at one point at least appeals to the theory of measure. The book thus falls between two stools; the first part is not sufficiently rigorous for an honours student, while the later part is too difficult for those merely reading for a pass degree.

(4) Dr. Rutherford's book gives an excellent elementary account of the algebra of vectors and of its application to differential geometry, dynamics and potential theory. The treatment is clear and concise, and the volume is remarkable for the wide range of topics treated in a small compass. It should prove a useful text-book on a theory which is now widely used in many different branches of mathematics.

(5) Dr. Ince's book deals concisely with the types of ordinary differential equations which are commonly studied in a university course. It follows the standard order of treatment, dealing first with the various soluble types of equations of the first order and then with equations of higher orders. The latter part of the book deals with linear equations, with constant coefficients and with the solution of equations in series, particular reference

being made to the hypergeometric equation and the equations of Legendre and Bessel. We should have liked to see a description of Heaviside's method for solving differential equations with constant coefficients included, as this useful method is neglected by most of the current text-books.

All these volumes are well produced and clearly printed. Their publication at a modest price will, we think, be widely welcomed.

(6) The other volume under review is of a very different kind. "Advanced Algebra" deals with such widely divergent topics as probability, diophantine equations, homographic transformations, and the elements of the theory of functions. The result is a book which is full of interesting things, but which is lacking in the unity of a text-book confined to a single topic. The first chapter deals, in an attractive way, with the algebra underlying the geometrical theory of homographic transformation, cross-ratio and involution ; it is a well-conceived piece of work, but the analyst will probably be puzzled by the phrase "any point at infinity is the z-plane". Next follows an account of the resultant of two quadratic polynomials, and of graphs of functions of the type $(ax^2 + 2bx + c)/(a'x^2 + 2b'x + c')$. The proof (on pp. 21, 22) that the resultant of two real quadratics is negative if, and only if, the roots of the two corresponding equations are real and separate from each other contains an error, but the reader will easily construct a valid proof for himself. The next four chapters deal with double series, uniform convergence, and the exponential and logarithmic functions of a complex variable, matters now usually regarded as belonging to analysis. Chapters on elimination and probability follow. The next, and in many ways the most interesting, part of the book deals with the elementary parts of the theory of numbers, continued fractions and diophantine equations. There is a very readable account of the theory of quadratic residues and Gauss's law of quadratic reciprocity, leading up to a discussion of primitive roots, of the expression of numbers as the sum of two or four integral squares, of methods for the factorization of large numbers, and of the theory of the binomial equation. A chapter is devoted to the solution in integers of equations of the form $x^2 + Ny^2 = M$. This is marred by an unfortunate mistake at the outset, where it is asserted that if (x, y) and (x_1, y_1) are two pairs of relatively prime integers such that $x^2+Ny^2=M_1M_2$, $x_1^2+Ny_1^2=M_1$, then the equation $x^2+Ny^2=M_2$ has integral solutions if M_1 is an odd prime, a power of an odd prime or twice such a number ; this theorem is not necessarily true if M_1 is an odd prime power, as is shown by the example $6^2+18{\cdot}5^2=81{\cdot}6$, $3^2+18{\cdot}2^2=81$, $x^2+18y^2\neq 6$ for any integral x, y. The book concludes with an interesting account of infinite continued fractions, an introduction to the theory of invariants, and an account of linear transformations.

There are numerous exercises in the text and a collection of miscellaneous examples at the end. The production is up to the high standard we expect from its publishers.

J. A. Todd.

THE CHEMICAL LECTURE BENCH

Lecture Demonstrations in General Chemistry
By Prof. Paul Arthur. (International Chemical Series.) Pp. xvi + 455. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 26*s*.

THE author of this useful manual rightly states that : "The task of the lecture demonstrator is unusually specialized, requiring, as it does, something of showmanship without submergence of educational objectives. Perhaps no other branch of teaching requires such nicety of balance and such care in presentation". The student who sees what appear to be simple experiments rapidly and successfully performed does not appreciate the long and difficult apprenticeship which makes such results possible, and the work of generations of university teachers which is embodied in a course of lecture experiments. It is only when he is called upon to perform these experiments himself, when he has usually to depend on his own resources, that these facts become familiar to the teacher. The number of really useful books to which he can then turn for guidance is quite small and any addition to this field of literature is, therefore, welcome. The keen lecturer, again, is always on the look-out for new experiments, and will be interested in such books.

The present work is noteworthy in its scope, which includes physical chemistry and organic chemistry as well as the usual experiments for the course in inorganic chemistry, and for its inclusion of many new experiments, several of these being collected from the *Journal of Chemical Education* and *School Science* and *Mathematics* (references to papers in these being given). The author has had experience in such work and the text shows that he fully appreciates the need for careful detail in the descriptions. Such detail is, in fact, essential, and as it can never be given in the space available in text-books, such a book as this is absolutely necessary as a supplement to these.

A large number of apparently simple experiments fail because some small detail has been neglected, and although some lecturers make a point of suggesting possible causes of failure and even think this has an educational value, they rarely hit on the real cause, and a succession of 'damp squibs' leads the student to doubt the validity of the statement that chemistry is an exact science. Lecture experiments should succeed if they are to fulfil their purpose. The causes of such failures are frequently stated in the book.

The ground covered is so wide that a detailed account of the book cannot be given. It may be said, however, that the inorganic chemistry section is well covered, although some excellent experiments are missing from it. The section on organic chemistry is brief and will require supplementing in a detailed course. The experiments on physical chemistry are particularly noteworthy, and there are many new demonstrations in this field. The physical properties of gases, solutions and colloids, energy and chemical change (including some good experiments on photo-chemistry), radioactivity, the ionic theory, electrochemistry and colloid chemistry are dealt with.

The author claims six major features for his book: wide scope, references to literature, accessibility, the selection of easily visible experiments which may be completed in a lecture period, suggestions as to the principles illustrated by each experiment, and adaptability to standard text-books. These claims are justified, and everyone who has to perform lecture experiments in chemistry will find the book useful and helpful.

THE SCIENCE OF ANIMAL BREEDING

Animal Breeding
By Prof. Laurence M. Winters. Third edition. Pp. viii + 316. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 21*s.* net.

ANIMAL breeding, says Prof. Winters, is the art of improving animals. As such, it depends for success on a skill of hand and eye which can scarcely be acquired from books, and indeed, in this third edition of his book, Prof. Winters is not so much concerned with the art as with giving students an up-to-date account of the science. His pages offer the younger generation of breeders and extension workers the gift of science to animal breeding—the organized knowledge which enlarges the scope and power of the enterprising craftsman. That the author now addresses himself to students involves an interesting transition, since the progressive breeder for whom the first edition was written has been deserted for the student whose background of fundamental sciences renders many modern investigations more intelligible.

Beginning with historical glimpses of the development of domestic animals, the book continues with the anatomy of the genitalia, the physiology of the breeding-cycle, the cytology of the gonads, and the technique of artificial insemination. Following this selection of applied sciences and at greater length is an exposition of inheritance which follows orthodox lines. Mendel's laws are explained and illustrated with some well-known simple examples, and then the more complicated genetic situations presented by selection and breeding for economic characters are considered. The choice of the most significant items from an enormous mass of literature is difficult, and it is scarcely to be expected that any two authors would agree on the way to do it. Experienced readers may therefore think that some subjects in which they are interested, such as adaptation to environment, the creation of new breeds, or progeny testing, have received too little attention for a text-book, and that others, such as selection and breeding systems, have not been considered sufficiently from the point of view of the breeder whose difficulties will ultimately have to be met by the student. The author's wide range of experimental studies with their practical background well qualifies him as a guide for students, so that it seems a pity he has not dealt more fully with improvement as the breeder sees it.

To enunciate a number of good scientific reasons for following a certain line of action is one thing; to decide which of the multifarious and often conflicting considerations that arise in practice should receive greatest weight is quite another; and ignorance of the latter often breeds distrust of the former. Another feature that might be criticized is the use of illustrations from the 1924 edition, for example, Figs. 69 and 117, which are rather poor by 1940 standards. Whatever may be said of the details of his treatment, no one can complain that Prof. Winters is satisfied with the present rate of improvement in livestock. He wants shows to be occasions for instruction rather than carnivals; record of performance tests made and used; artificial insemination, cross-breeding and heterosis exploited. In short, he wants progress to be hastened by all available methods, a desire which all his readers will share.

H. P. Donald.

The Principles of Electric Power Transmission by Alternating Currents

By H. Waddicor. Fourth edition, revised. Pp. xxi+458. (London: Chapman and Hall, Ltd., 1939.) 21*s.* net.

THAT this well-known and valued text-book, first published in 1928, has appeared in its fourth edition is a remarkable achievement and bears testimony to the author's ability. The principal alterations introduced in the present edition refer to underground cables, and recent extensive research and development work in connexion with the thermal properties of cables is set out in the revised Chapter x. There is an excellent bibliography with up-to-date references. For some obscure reason the index is not so complete as could be wished; for example, the name of J. A. Fleming appears in the text but not in the index.

When dealing with the theory of electrically long lines, the author evidently prefers the term "line angle" for the complex quantity $\sqrt{ZY}$, rather than the "propagation constant" commonly used in telecommunication practice and by other writers on power transmission. Students at universities and technical colleges, to whom the author refers in the preface to his book, are likely to desire a wider and more generalized outlook on transmission problems and theory. In view of this, it is hoped that, in a future edition, at least mention may be made of attenuation, wave velocity and the conditions underlying reflection in long lines. Recent developments in the protection of high-voltage transformer windings (non-resonating) are mentioned but no details given.

The book is well illustrated and beautifully printed, and in the reviewer's experience is known to suit the requirements of students of power engineering, and for such the book is recommended without reserve.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 35: Aluminium. Teil *A*, Lief. 6: Legierung von Aluminium mit Mangan bis Rhenium. Pp. 887–1110+xxii. (Berlin: Verlag Chemie, G.m.b.H., 1939.) 27.75 gold marks.

A COMPREHENSIVE account of the composition, chemical and physical properties of the alloys of aluminium with manganese, nickel, cobalt, silver, gold, platinum and various other metals is included in the part of "Gmelins Handbuch" under notice. The views of various authorities on the composition of the solid phases in the system Al–Mn are contradictory and are set forth in a series of diagrams for comparison. Four intermetallic compounds, Al_6Mn, Al_4Mn, Al_3Mn and AlMn, have been identified, of which only the last-mentioned has a congruent melting point at 1287° C. These alloys are not affected by dry air, but disintegrate when the air is moist. Aluminium mixes with nickel in all proportions in the liquid state and a compound, AlNi, separates at 1640° C. The slow disintegration of these alloys in moist air is accelerated by the presence of other intermetallic compounds.

Much space is given to the alloys with silver, although there is still some uncertainty about the composition of the solid phases in alloys containing more than 14 per cent of aluminium. Whereas the solubility of aluminium in silver varies between 5·1 per cent at 200° C. and 6·52 per cent at 500° C., that of silver in aluminium increases from 0·75 per cent to about 48 per cent in the same temperature range. The intermetallic compound Ag_3Al melts at 779° C. Several ternary and quaternary alloys are also discussed in this number, which is packed with detail and well illustrated with diagrams.

Direct and Alternating Currents

Theory and Machinery. By E. A. Loew. Second edition. Pp. xv+730. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s.*

THE second edition of this text-book is a creditable effort on the part of the author to cover, in a single volume of 730 pages, the extensive field embracing the theory and applications of direct and alternating current circuits, machinery and apparatus. Numerous examples are given to illustrate the principles of direct current and alternating current machinery and in addition there is a selection of problems, at the end of most chapters, which are suitable for tutorial classes. The treatment of the subject is of an introductory nature, but, although not sufficiently advanced to suit the requirements of a degree course syllabus in a British university, this book would assist students attending a course of lectures on a general survey of the subject of D.C. and A.C. machinery and apparatus. Throughout the book there is evidence of the restriction, imposed by lack of space, on the treatment of the problems involved and this offsets much of the gain in having the whole subject in a single volume.

The final chapter, on thermionic apparatus, while commendable as a brief and interesting survey, would have been much enhanced in value had the author included worked examples and a selection of problems.

Direct-Current Machinery

By Prof. Hempstead S. Bull. Pp. vi+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s.* net.

A STUDENT having limited time for the study of the principles of direct current machinery will find this book useful as a general survey of the subject. The treatment is elementary but, so far as it goes, is satisfactory and well presented in the 318 pages and adequate illustrations.

As there is little matter not to be found in existing text-books this is a disappointing feature and renders the book of little use to the advanced student or designer. Each chapter is provided with a useful bibliography, mainly American, and a set of problems.

The importance of the direct current motor has resulted in notable advances in the available information about heating and improvements in the design and construction of modern machines. The book contains little information about temperature rise and the disposal of heat generated in the active materials, and therefore cannot be regarded as an up-to-date treatise.

THE VITAMIN B COMPLEX IN NORMAL NUTRITION*

By Prof. C. A. Elvehjem,
University of Wisconsin

During the last decade, distinct advances have been made in our knowledge of the chemistry and physiology of vitamins. Perhaps some of the most interesting observations have been made in the field of the vitamin B complex. There may be two reasons for this situation. First, the chemical structure of the water-soluble vitamins is somewhat less complicated than that of the fat-soluble vitamins. Vitamin B_1 was first synthesized in 1936, and we have seen an average of one B vitamin synthesized a year since that time. Secondly, at least three of the B vitamins have found their physiological function as prosthetic groups of enzymes in very important enzyme systems. The work on the relation of these vitamins to metabolism has not only aided us in understanding the function of the vitamins, but in many cases it has also helped us to understand the intricacies of metabolism itself.

How can some of the newer information about the B vitamins be used to improve public health ? We certainly have a new problem to consider in connexion with the proper use of synthetic vitamins. This is especially true in the case of the B complex, since we now have five factors available in synthetic form. Each year we see a tremendous increase in the promotion of commercial vitamin preparations containing the purified components. Does this mean merely a temporary enthusiasm because of the availability of these synthetic compounds, or does it mean a definite need for the addition of some of these factors to our regular diets ? There are certain principles which should be kept in mind regardless of whether we are dealing with vitamins as a group or with specific components.

First, vitamins should be obtained from natural foods if possible. Generally they are cheaper, more palatable, and in better balance with other factors when taken in this form. Those individuals who enjoy normal health may wonder why anyone would expect to get vitamins from any source other than his food. However, from the number of inquiries made regularly concerning the use of concentrates, it is apparent that a relatively large percentage of people are not convinced that they get adequate vitamins from natural foods. If we are to accept the above principle, we must recognize that the distribution of the individual factors in foods and the requirement of each factor must be established as rapidly as possible. This is a large assignment, but with the continual changes taking place in our available foods as well as in the types of foods consumed, we can only hope for complete dietaries if we know how these changes affect our vitamin intake. Of course, one may say that the ideal way to combat this situation is to return to the use of less-refined foods and use more of the crude products familiar to our forefathers. Some progress in this direction may be made through educational programmes ; but it would be just as difficult to return to the diets used by our forefathers as it would be to return to the use of less-refined foods and use more of the crude products familiar to our forefathers. Some progress in this direction may be made through educational programmes, but it would be just as difficult to return to the diets used by our forefathers as it would be to return to the use of the horse and trap. During the past fifty years our environment has become limited to the grocery store and the chemist's shop. Our natural foods are packaged and devitalized and the vital elements are concentrated and sold in the chemist's shop. How are we to know what to buy from the grocer and what we should get from the chemist ?

The difficulties encountered in obtaining the above facts are obvious to many of us. There is inadequate information concerning the vitamin content of foods actually consumed, and human requirements are not well established. Many of us in working on nutrition have been busy showing pictures of deficiencies in experimental animals rather than dealing with the more fundamental problems. In other words, we have been more interested in the methods used in reaching our goal than in our destination. Another imprint which animal work has left upon us relates to the glorification of certain foods as important sources of specific vitamins. The nutrition worker in his haste to make concentrates usually assays only a few foods, and if he finds one that is fairly rich, this food becomes the recognized source of this factor, while actually other foods may quantitatively be a more important source in the diet.

Most workers agree that the daily requirement of thiamin is 1–2 mgm. or 300–600 I.U. a day. It is not impossible to plan a diet which supplies this amount, but it is not a simple task. Foods that are good sources of thiamin are limited largely to beans, peanuts, oatmeal, and pork products. Stiebling and Phipard in an extensive survey found the daily thiamin intake in all the groups studied to be more than 240 I.U. This figure was based on literature values for the food consumed, and it should be emphasized that loss due to cooking of the food was not taken into consideration. Baker *et al.* have concluded that the best-fed English population, while getting twice as much thiamin as people in the low-income group, consume less thiamin than the parish poor of the eighteenth and nineteenth century.

---

* Substance of a paper presented on September 17 at the Bicentennial Conference, University of Pennsylvania.

The reason for this low thiamin intake is, of course, obvious. According to Joliffe, cereals supplied 32 per cent of our calories in 1840 and only 24–25 per cent to-day. The flour used in 1840 contained 75 per cent of the original vitamin B_1 and to-day white flour contains only about 10 per cent of the original vitamin. The *per capita* consumption of sugar has increased from 8 lb. to more than 100 lb. Cereals and sugars comprise about 50 per cent of our diet. Thus a 50 per cent fraction of the calories which in the diet of 1840 provided 600 I.U. has been replaced by one furnishing but 50 I.U. This large consumption of devitalized energy foods may be more serious than we realize, but so far as vitamin B_1 is concerned the situation is not too difficult. The problem merely centres around the vitamin B_1 content of the remaining 50 per cent of the diet. Many people feel that the use of white flour is the cause of many of our nutritional ills. Again limiting the discussion to vitamin B_1, I see no objection to the use of white flour or products made from white flour provided we recognize its limitations and compensate for the decreased intake of vitamin B_1 by other foods. A pork sandwich made with white bread may supply more vitamin B_1 than a jelly sandwich made with whole wheat bread. The situation may be more serious in areas where supplementary foods are not available, and thus any attempt to increase the vitamin B_1 content of bread should be welcome by anyone interested in nutrition.

The daily requirement for riboflavin is also about 1–2 mgm. a day; but it is not difficult to obtain this amount from an average diet containing milk, vegetables and meat. Only 10 gm. of dry liver, equivalent to 2 ounces of fresh liver or a pint of milk, will supply the daily requirement. Cereals are extremely low, and any diet high in sugar and refined cereals and low in milk and animal tissues is likely to be deficient in riboflavin. Due to the availability of the bacteriological assay method, which is a great improvement over the time-consuming assays, greater progress is being made both in regard to the incidence of riboflavin deficiency and the distribution of this factor in a greater variety of foods. The incidence of riboflavin deficiency may be greater than was at first realized.

It is quite obvious that some people have had difficulty in getting a sufficient quantity of nicotinic acid from their regular food supply. Let us assume that the daily human requirement for nicotinic acid is 10 mgm. In order to get this amount one would have to eat about 2 lb. of corn meal, which is, of course, impossible. This may be an extreme example, but very many of our foods contain between 2 and 10 mgm. per 100 gm. on the dry basis, which means that we would need anywhere from 1 lb. to 1¼ lb. of these foods to supply the daily requirement. The fact remains that the only excellent sources of nicotinic acid are animal tissues, yeast, and perhaps certain vegetable materials. The original thesis of Dr. Goldberger, that a small piece of lean meat may determine the incidence of pellagra, has not changed in spite of all the newer information. The determination of the nicotinic acid content of foods has been limited largely to assays with dogs; but within the past six months chemical methods have been developed which appear to be satisfactory.

The vitamin B_6 content of foods is not clearly established, due to difficulties in the assay procedures. The existence of this factor grew out of experimental work with rats in attempts to produce a pellagrous condition similar to that observed in humans. The cure or prevention of the acrodynia in rats has been used for assay purposes; but a complicating factor enters the picture, since fats high in linoleic acid will cure the acrodynia about as rapidly as vitamin B_6. During the past year we have developed an assay procedure which is based upon growth rather than the prevention of dermatitis, and we feel that rather accurate values can be obtained by this method. For example, we have found kidney to contain 25 γ, liver 10–20 γ, and pork ham 26 γ per gram dry material. However, extensive assays are required before we can actually calculate the vitamin B_6 intake on different diets.

We are somewhat more fortunate in the case of the distribution of pantothenic acid in foods, since both the chick assay and the improved bacteriological method give quite definite values. However, we know very little about the human requirement for pantothenic acid. In fact we obtain rather peculiar results if we attempt to study the amount needed by rats. 25 μ gm. per day may suffice if all the other members of the B complex are supplied; but in the absence of certain members increasing rates of growth may be obtained by raising the intake from 25 γ to levels of 150 γ per day.

If we have difficulties with the first five members of the B complex, which are now fairly well known, one can imagine the problems encountered with the newer ones such as factor *W*, the anti-grey hair factor, and several others the existence of which has been established through studies with dogs and chicks. We may have the advantage that in many cases a food rich in one member of the B complex may also carry appreciable quantities of the other factors. However, this generalization cannot be carried very far. Thus cereals may be a fair source of thiamin and pantothenic acid, but a very poor source of riboflavin, nicotinic acid, and probably vitamin B_6. Vegetables are a good source of riboflavin but low in thiamin and pantothenic acid. Liver is an excellent source of most of the B vitamins, but is rather low in thiamin. Even milk, which supplies adequate amounts of all the factors when used as the sole article of diet, becomes limited in thiamin and nicotinic acid when diluted with inert energy foods. We are, of course, very fortunate that while we are designing our diets some of the unknown factors are thrown in without our knowledge.

The second principle which we should consider is that concentrated forms of vitamins may be used effectively under many conditions, but there is no virtue in using such preparations merely because the vitamin is present in concentrated form. In other words, one gram of a product containing 100 units of a vitamin may be no more valuable than 100 grams of food containing 1 unit per gram. In most cases the 100 grams of food would be much better, since it might contain 100 units of several different factors.

Concentrates, of course, have a very definite place in clinical medicine, and in cases of emergency the pure crystalline synthetic vitamin may be even more valuable than the concentrates. There are many valuable concentrates on the market, and these may be very valuable for patients on restricted diets. Often foods supposedly rich in certain vitamins have been used as a source of these factors without consideration of the digestibility and irritating effect of these bulky foods.

So far as we know, the synthetic forms of the B vitamins show the same biological activity as the naturally occurring forms. We know that vitamin B_1 must be converted to cocarboxylase, riboflavin to several different respiratory enzymes, and nicotinic acid to coenzymes I and II before these vitamins can function; but apparently the body is able to build these compounds if the vitamin precursors are supplied.

There is much that can be said about the misuse of this form of diet therapy, but there is one point worthy of emphasis. There is an undue effort to get the vitamin in concentrated form. If a product containing 10,000 units per gram is good, then one that contains 1,000,000 units must be 100 times better. Thus the manufacturer takes a material like yeast, extracts, adsorbs, elutes, precipitates, etc., until he gets a small amount of material very rich, let us say, in thiamin, but of necessity lacking in most of the other factors originally present in yeast. The other factors have not only been lost, but the expense of all these manipulations has also increased the price of the vitamin that is left out of all proportion to its original cost. We are beginning to recognize that nutritional deficiencies are apt to be multiple, and if a person has lived on a diet low enough in nicotinic acid to produce pellagra, it is also likely to be low in vitamin B_1, riboflavin, vitamin B_6, and perhaps others.

For many years residues from liver extract after the removal of the pernicious anæmia factor were completely ignored so far as nutritional values were concerned. More recently its value as a source of the B complex has been recognized; but even now attempts are made to sell fractions from the material on its riboflavin content or its pantothenic acid content. Liver extract is an excellent source of practically all the B vitamins except vitamin B_1. I hope someone can convince the commercial laboratories to leave this material at least partially intact because it still contains several unrecognized factors.

This brings us to the question of mixing natural concentrates and synthetic vitamins. Certainly in many cases this practice is objectionable, but in the case of related factors it may have some value. If we have a concentrate containing a combination of B vitamins and it is especially low in one of the components, the proper ratio may be restored by using a synthetic product. In fact, so long as there are unknown vitamins it may be well to include a certain amount of a natural product. One thing we must watch out for is the introduction of one vitamin out of all proportion to the others merely because this particular one happens to be relatively cheap. Often a commercial preparation is not compounded on the basis of the relative requirements of the individual vitamins but on the basis of the availability and cost of the component vitamins. However, I believe that many of these difficulties will be remedied as soon as nutrition workers make the facts available.

We have already mentioned that it may be difficult to get 1 mgm. of thiamin from our daily food supply; but there is no difficulty in supplying a patient 50 mgm. from a bottle of thiamin. I have no argument with a physician who can prove that he obtains some beneficial effect from massive doses of thiamin, riboflavin, nicotinic acid, etc., but from a nutritional point of view, such massive therapy means pure waste of material.

We now come to the question of adding vitamins directly to foods, or the question of fortification. The third principle which I should like to mention is that there is no fundamental objection to the addition of synthetic vitamins to food materials. We have accepted the addition of salt to our foods, and in this specific relationship I see no difference between the addition of sodium chloride or iodide and, let us say, thiamin. The addition of synthetic vitamins may be cheaper, less objectionable to our taste, and more easily controlled than relying upon specific foods or concentrates.

Most authorities agree that the fortification of milk with vitamin D is a logical procedure, and through this means many children have been protected against rickets with no extra cost. In the case of nicotinic acid, the daily requirement costs 3 cents as nicotinic acid and at least 10 cents and more in the case of almost any food you wish to buy. Surely this is a question worth considering when pellagra is an economic disease. Workers who had tried adding natural concentrates to foods, such as flour, find that even those prepared with a minimum of colour, odour and flavour are quite unsatisfactory. Certainly the addition of synthetic vitamins to foods will ensure a more uniform product than even Nature itself can produce. Dr. Roberts has suggested that the chief danger in fortification of foods is that it might tend to give a false sense of confidence that all the deficiencies of refined foods have been overcome. Surely the standardization of the amount of one vitamin in one food cannot give us false confidence any more than the standardization of the fat content of milk, which has been controlled by law for many years.

This does not mean that we are ready for the fortification of foods—there are many difficulties. I have mentioned the advantages merely because they are generally overlooked. However, it is rather amusing that many more objections are raised when a commercial company wants to add a vitamin to a food than when new processing methods are introduced which are known to be destructive to the vitamins. The difficulties encountered in fortification are so interrelated that it is difficult to know at what part of the cycle to start the discussion. Perhaps it is best to recognize first that the processing of foods removes more than one vitamin. Thus the addition of a single crystalline factor only partially restores the original value of any food. In the case of pellagra the diet is deficient not only in nicotinic acid but also in thiamin, riboflavin, probably other members of the B complex, etc. The ideal method of preventing pellagra would be to increase the meat and milk consumption, but if this is economically impossible, I see no objection to at least studying the possibility of some sort of fortification. Dr. Spies has pointed out that the use of nicotinic acid alone may lead to the development of more serious conditions, but why not also study the possibility of using other vitamins as well ? If we want to object to studies of this kind, we could go one step further and ask, why improve nutrition at all ? If you do, people will only live long enough to die of old age.

I hope you do not misunderstand me and think that I am promoting the fortification of foods ; I am merely trying to counteract some of the dogmatic statements that have been made and to present both sides of the subject. It is just as easy to demonstrate the difficulties encountered by animal experiments as it is in the field.

At the present time any attempt to add the several vitamins which are apparently necessary would merely increase the cost of the foods and move them farther than ever from the reach of the population group needing them most. The most logical approach appears to be controlled vitamin content of foods. Let us train the farmer that the vitamin content of his product determines to some extent the value of his product. Perhaps the geneticist could be induced to breed new crops for their vitamin content rather than for their yield of dry matter ; and perhaps some day we may educate the entire public to use the animal carcase in such a way as to utilize the vitamins present to the greatest advantage.

If industry removes too much of the vitamins during processing, some sort of restoration should be practised. This does not mean that each industry should try to make a complete food out of each of its products. We are still interested in a large variety of foods, some being consumed merely because we like them ; but when the final accounting is made we should have an adequate supply of all the factors. Each component of our diet should carry its fair share of the vitamin burden. Returning to our friend white flour, it apparently does not carry its share of vitamin B_1. However, from the interest shown in this problem it should soon be able to hold its own in the combat. A greater part of the original seed may be left in the flour, certain concentrates may be added, synthetic thiamin may be added, or a yeast especially high in thiamin may be used for making the bread. Further experimental work will help solve the problems, although as time goes on more difficulties will arise ; but if the agriculturist, the processor, the medical man, and the man in charge of control work will work hand in hand for the sake of improved health, deficiency diseases should be reduced to a minimum.

CULTURAL UNITY IN THE AMERICAS

SHORTLY after the Pan-American Conference in Havana last summer, Mr. Roosevelt was reported to have made a statement in which he said that the embargo then recently placed on certain exports from America was to be regarded as an American defence measure, following upon the spiritual unity which had been established in the Americas by that meeting of representatives of the American Republics. While pan-American unity thus appeared to have been held by the President of the United States as more of an accomplished fact than ever before, there were other observers, well acquainted with conditions in the Latin Americas, who did not share his optimistic view of the possibilities of securing co-operation from Central and South America in any and every action which the United States might elect to take in the defence of the western hemisphere against the aggression of non-American, or in other words against the Axis, powers. One well-informed writer, indeed, went so far as to say of the Latin Americas: "They are not interested in fighting for democracy *per se*, or for the integrity of the hemisphere as Washington sees it."

It was in fact then suggested that the attitude of the Latin States was one of watching and waiting for the turn of events in the Old World before committing themselves definitely in overt action which would define more precisely their policy in relation to the belligerent powers.

On the British side, the re-election of Mr. Roosevelt as President for a third term of office has ensured the continuance of the 'good neighbour' policy in the relations between the United States and the peoples to the centre and south. On the other side the result of the presidential election as a substantial check to those in the States who advocate a defensive policy which ends at Panama, as well as the course of recent events, in the theatre of war, while undoubtedly favourable to Mr. Roosevelt's aim to mould the Americas into a united whole, may equally well confirm the Latin Republics, at any rate for a time, in a further period of opportunist watchfulness. If the aim of the Axis powers is to embroil America and thus weaken her capacity to assist Great Britain, the attack on the Americas, owing to the development of the European situation, can come, if it is immediate, only from Japan. For the moment, the Nazi threat to South America, directed from Africa, is in abeyance. Japan must strike first at the United States, and it might well seem to the Latin peoples of America that their interests can wait on the outcome of this contest without detriment. On the other hand if, as Mr. Roosevelt claims, the movement towards unity is more deeply rooted than in political expediency, and springs from a fundamental spiritual principle to which all the peoples of the Americas equally feel themselves irrevocably pledged, the prospect of a western hemisphere united against any aggressor who threatens their liberty of thought and action is by no means so indeterminate as Mr. Roosevelt's critics would have us believe.

No close union between peoples can last for any length of time if it is based entirely on political expediency. It crumbles as the reason which called it into being fades into the background. If the tie is to endure it must be woven of that idealistic community of interests and outlook which is drawn from a common heritage and from common elements in the culture of those whom it is sought to unite. At first sight it may seem that such common elements are to seek in the ways of life of the peoples of the Americas. If the relatively negligible influence of the Italian immigrant population of the United States be ignored, and the by no means entirely negligible effect of German and British elements in Central and South America be set aside in this connexion, as it may, the cultural history and social environment of the peoples of America north of Mexico is almost entirely derivative from Northern and Central Europe, while those of Central and South America are drawn from Southern Europe, their source the cradle of Latin civilization. On broad lines the differences which mark these two sources of the American peoples and civilizations may be summed up in the statement that, while one was in religion and sentiment Roman Catholic, the other has been drawn predominantly from members of the Protestant forms of the Christian faith with a bias towards the Calvinistic. The implications of this distinction and the cultural differentiations which are in fact found in association with the two forms of the Christian faith have been further emphasized, not to say exaggerated, in the development to which they have been subjected in a period of comparative isolation from outside, and more especially European influence, since the earlier migrations of the sixteenth and seventeenth centuries. If North America has received a large influx of immigrants in the later nineteenth century, it has speedily assimilated them to its own pattern, while Central and South America, ever since the days of the Conquistadores, have moved away from their European origins by approximation to indigenous forms of culture and belief, thus still further widening the gap in cultures and outlook which originally marked them off from the North.

This differentiation is most readily perceptible in the lower strata of the Latin population, in which the effect of miscegenation with the indigenes is most to be remarked. Among them culture and religious belief have assimilated closely to native types under the influence of social and geographical environment. So true is this that in Mexico, for example, native elements grafted on to Roman Catholicism have evolved a synthetic form of religion in which pagan and Christian elements are inextricably mingled, but none the less combine to form a whole which completely satisfies the emotional and social needs of the population.

It is a common, but by no means inexcusable, misconception, which regards the Latin American Republics as one in culture and character. The variation between them is considerable, depending to no small degree on the extent and character of their assimilations to the indigenous population. So strongly marked indeed was this differentiation that when Bolivar, the great liberator of South America at the beginning of the nineteenth century, endeavoured to form a federation of the three States of Venezuela, Colombia and Ecuador, he failed owing to differences in outlook and social and religious habit of mind. These same differences, it is to be noted, still persist as marking off the peoples of these States one from another. A further source of misconception arises from the fact that the Portuguese origin of Brazilian culture, with all its implications, is not given its full weight. Portuguese settlers in Brazil, even more than the noble Spanish settlers in the Argentine, who are largely responsible for social conditions in that State to-day, endeavoured to reproduce in their new South American home the conditions which ruled on their ancestral lands in Portugal, recreating the distinctive type of large land holdings or *fondas* to which they had been accustomed. Further, they brought with them a readiness, derived from their racial history and custom, to overlook the colour line in their matrimonial alliances, both temporary and permanent. The Brazilian population consequently has a high percentage of admixture of both indigenous Indian and negro slave blood. It affords a strong argument in support of those who regard artistic efflorescence as one result of crossing with a negro strain. Since the South and Central American Republics broke away from European influence in the last generation and began to develop upon national lines in the arts, Brazil more than any other has forged ahead, especially in music and in the development of a literature of its own.

It is neither possible nor necessary here to enter more fully into a description of the qualities and characteristics which give each and every one of the republics of Central and South America an individuality all its own over and above the very generalized and much modified heritage of a Latin form of civilization. Enough has been said, however, to show some of the difficulties which confront any endeavour to secure a close co-operation with the North destined to survive anything more than the urge of an immediate and insistent peril. The President of the United States, in his call to the American Republics to co-operation, relies upon the devotion of all to the cause of liberty and their determination to preserve the freedom of the individual in thought and action. Yet cynical observers have admitted a doubt whether to the South American liberty means more than the right to revolution in order to resolve a situation to which democracy would put an end by resort to the polling booth.

It is clear that if any measure of that closer co-operation of the American Republics desired by President Roosevelt is to be attained, it will demand a great deal of give and take, and can be based only upon mutual understanding of the different ways in which the two groups of peoples react and have reacted to the stimuli of a developing civilization. This is fully realized among certain sections of opinion in the United States, among whom a movement has been in progress since 1936 for fostering study and understanding of the culture of peoples outside the United States. One of the results of this movement has been the holding of symposia, of which the first, which took place in 1939, was devoted to the culture of the peoples of Central and South America. In a report of this symposium published recently*, distinguished authorities have surveyed the recent cultural development and in some instances the cultural history of the more important States. The Argentine, unfortunately, was not represented. Without entering into detailed discussion, it may be said that, as a whole, the contributions emphasize not merely the differentiations to which reference has been made above, but also the strong individuality in intellectual life and social consciousness which recently has come into being and shows a healthy development in the majority of these States. If the future existence of the Americas depends upon co-operation, it is safe to predict that the extent of the contribution of that union to world order will be in direct ratio to the measure in which it will have been found possible to preserve the cultural individuality of its units.

---

* Concerning Latin American Culture: Papers read at Byrdcliffe, Woodstock, New York, August 1939. Edited by Charles C. Griffin. (Published for the National Committee of the United States of America on International Intellectual Co-operation.) Pp. xiv+234. (New York: Columbia University Press; London: Oxford University Press, 1940.) 13*s*. 6*d*. net.

THE RUMANIAN EARTHQUAKE OF NOVEMBER 10

By Ernest Tillotson

On October 22, at about 8.30 a.m. local time, a strong earthquake with epicentre probably near Barlag shook a considerable area in Rumania (see Nature, November 9, p. 615). In Bucharest it cracked buildings, throwing some people out of bed, also overturning movable objects. In one hotel it threw a breakfast tray fully loaded from a table to the ground. By radio and special editions of the newspapers, the people were led to expect a more intense shock, and many stayed out of doors all day. One did not come that day. It is safe to predict that an earthquake will probably reaffect an area once affected, but it is folly in the present state of seismological knowledge to predict just when and where an earthquake will occur.

The predicted return came all too soon, unexpectedly, on November 10 (see Nature, November 16, p. 647). It was heralded by minor tremors in various parts of the Balkan States on the night of November 9, but the terrific shock came on November 10 in the early morning. For what appeared to be an age, but actually for perceptibly five minutes, Bucharest and most of Rumania and the surrounding area shook more than they had done since 1802. The people of Bucharest knew it when, with a terrific crash, their new eleven-story Carlton flats crumpled into rubble. Nor was this all. The new building of the Foreign Ministry cracked from top to bottom. The Royal Palace and the headquarters of the Rumanian Army were severely damaged. The great pillars of the Post Office fell, and one crushed a motor-car and its occupants in the street. The gallery of the National Theatre crashed into the pit, and among other buildings two hundred were destroyed and four hundred damaged. Heavy rain fell while medical men, chemists, engineers, architects and private citizens called by the radio, assisted by firemen, the Iron Guard and the German troops, searched the wreckage for those trapped. Fires broke out and basements became flooded. More than a hundred and fifty are known to have been killed in Bucharest alone, and it is feared that thirty or more people are trapped beyond hope of rescue in the Carlton flats. More than a thousand badly damaged houses have had to be evacuated in Bucharest, and there is scarcely a house not affected in some way. The British Legation building had some of its inner walls cracked but was otherwise only slightly damaged.

Other areas in Rumania, including the oilfield towns and the port of Galati, were no less affected. At Ploëşti, after a vivid flash of lightning which put the telephones out of action, the earthquake severely damaged the town hall, a hotel, and the Standard Oil Company's offices. The refineries of the Standard Oil Company also have been compelled to close for ten days while repairs are done chiefly to the pipe lines. In this town also the prefecture, the chamber of commerce, and a number of private houses were destroyed, and sulphur fumes escaped from ground fissures. The Astra Romana Oil Company plant was damaged and fires broke out. At Focsani, an oil town, 70 per cent of the houses in the centre of the town are said to be razed and hundreds of people rendered homeless. At Giurgiv, an oil port on the Danube, 65 per cent of the houses are reported destroyed. At Buzeu, about sixty miles north-east of Bucharest, hundreds of buildings have been destroyed and many people killed. Damage has been done at Ramnicue and Sarat and half the villages in the Prohava oilfields have been razed. Pangui is said to have been completely destroyed and there are twenty-three dead and seventy-one seriously injured. At Jassy; four were killed and six gravely injured. In the whole district tens of thousands of peasants are homeless and the casualties are only small because of the flimsy nature of the peasant buildings.

Damage to the oil wells themselves is uncertain at present. The only fire was quickly extinguished and the pipe lines and steel casements are being examined. The prison for political prisoners at Dostrana near Campina collapsed and about a hundred people were killed. Galati, the grain and oil port, suffered severely. The cathedral and St. Helen's church were destroyed, scores of houses severely damaged, and the casualties were reported as thirty-six killed and a hundred and thirty injured. At Rutschuk, just on the Bulgarian side of the frontier, ten houses were damaged and fifteen persons injured. At present it is difficult to assess the total damage in the whole area. Telephone communications are still interrupted, and some railways have not yet resumed operation pending the examination of tracks, lines, and bridges. A conservative estimate puts the total damage at two and a half million pounds and the casualties throughout the country as four hundred killed and eight hundred severely injured.

Outside Rumania, the shock was felt in Sofia and many parts of Bulgaria though no damage is reported except at Rutschuk. It was also felt at Istanbul in Turkey, and in Moscow an earthquake at 4.40 a.m. local time stopped some clocks and moved some furniture. In Russian-occupied Poland, buildings are said to have been destroyed at Kishinov and Lwow, while at Brazov in the Carpathians terror was caused.

From all this information it is possible to construct provisional isoseismal lines. The Modified Mercalli Intensity Scale of 1931 as used by the United States Coast and Geodetic Survey has been used, which ranges from 1 to 12. A few outstanding intensities might be mentioned :

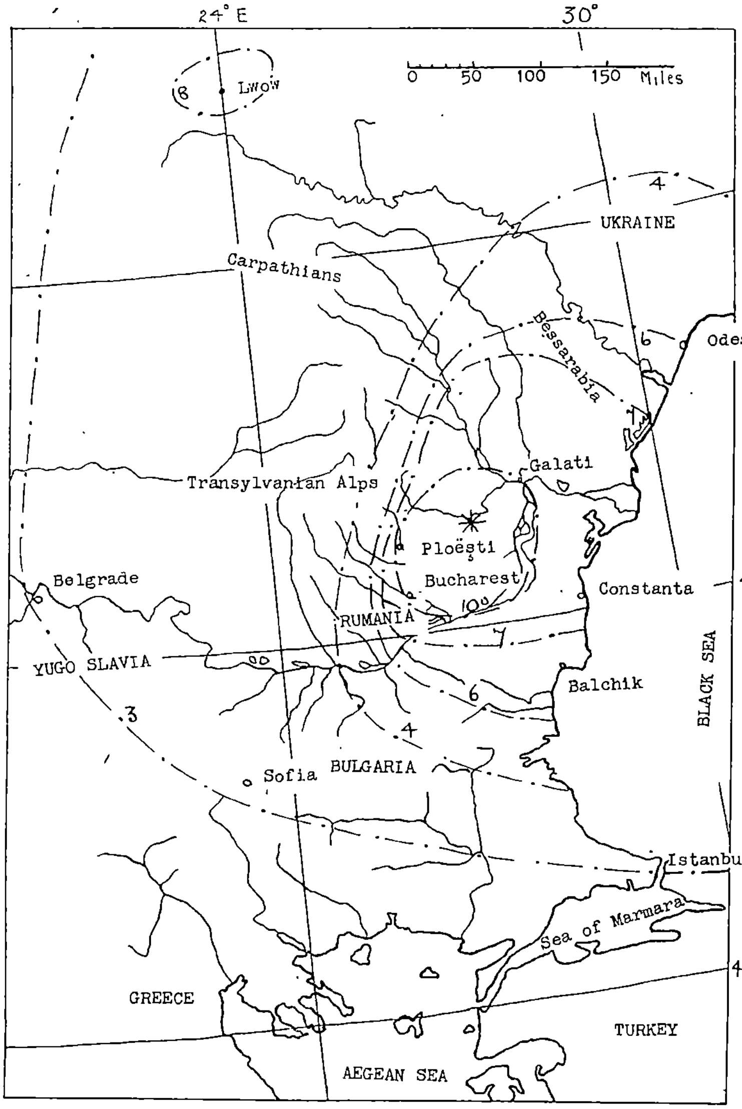
1, not felt except by a very few in especially favourable circumstances ;

5, felt by nearly everyone; plaster cracked ; unstable objects overturned ;

10, most masonry and frame structures destroyed with foundations ; ground badly cracked ; landslides from steep slopes ;

12, damage total ; waves seen on ground surfaces ; objects thrown upward into the air.

It will be seen that the shock reached intensity 10 on this scale in the epicentral area but not 11 or 12, which are extremely rare. There are, however, some curious points. In the Carpathians at Brazov the shock had diminished to intensity 4 ; but if it was the same shock at Kishinov and Lwow in Poland, it had again increased in intensity to 8 at these places, and was even of intensity 5 in Moscow. At first sight it appears as though there may have been two shocks at very nearly the same time. A thorough examination of the seismograms from near stations would decide this point. Reports from Odessa, the grain port on the Black Sea, indicate that intensity 6 was attained there, while Belgrade, Sofia and Istanbul experienced the earthquake at intensity 3.



Sketch map of Rumania and the surrounding area showing isoseismal lines on the Modified Mercalli Scale

Isoseismal lines, —·—·—·6·——; *, epicentre.

Only isoseismal lines for which there is evidence have been drawn on the accompanying map, though it appears that, with the exception of the region near Lwow, the intensity of the shock decreased fairly regularly with increasing epicentral distance. Immediately towards the west of the epicentral area the isoseismals indicate a more rapid falling off at first than in other directions. This may be due to the geological structure. It is noticeable that the isoseismals cover a very wide area, which may point to a focus rather deeper than normal. The wide area covered by the isoseismal 10 and lack of further macroseismic evidence makes it difficult on these grounds to pin-point the epicentre.

It was tentatively suggested by the Meteorological Office in Sofia that the epicentre was about 210 miles from Sofia, but the centre of the inner isoseismal is at a rather greater distance than this. At the moment it is more correct to speak of an epicentral area than of an epicentral point.

I am indebted to the Rev. J. P. Rowland, *S.J.*, for the Stonyhurst east-west Milne–Shaw seismogram of magnification 150. This has certain peculiarities which are well worth mentioning. Of the first waves to arrive, *P* were impulsive at 01h. 43m. 45s. G.M.T., the double amplitude being nearly 4 inches. These waves had nearly died down when a very strong impulsive *S* wave arrived at 01h. 47m. 17s. G.M.T. The maximum amplitude for the whole shock appeared to be an *S* wave coming immediately after the *S* onset. It exceeded the limits of registration (paper 9 in. wide) and the *S* waves included some oscillations too rapid to be recorded. Father Rowland estimates provisionally that the ground oscillation at Stonyhurst was at least one eighth of an inch. The surface waves (*L*) had a maximum double amplitude on the seismogram not exceeding 3 inches, and the waves from the shock had not quite died away after nearly 4 hours. *PP*, *PPP*, P_cP, *SS*, *SSS* and S_cS waves could be discerned but no *PS*, *PPS* or *SSP* waves. *sP*, *sS* and SR_1 pulses were identified but not *pP*. Three of these latter are characteristic of earthquakes with a deeper focus than normal, and from the Brunner Chart a depth of focus of 300 km. was estimated together with an epicentral distance of 2,330 km., or nearly 21°.

I am indebted to the Director for the readings of the Kew seismogram. *iP* (dilatation) occurred at 01h. 43m. 18s. with the epicentral distance estimated at 2,090 km. The onsets, maxima and periods of the various phases were very similar to those at Stonyhurst, and the waves could be traced for more than 4 hours. An average estimate of the initial time of the shock is November 10, 1940, 1h. 39·2m. G.M.T. and the epicentre near latitude 45° N., longitude 27° E.

There has been some discussion in Great Britain, South Africa and the United States (NATURE, January 6, 1940; March 16, 1940; and *Earthquake Notes*, September 1940) of the possibility of the waves from one large earthquake acting as a trigger action for an earthquake in another part of the world. The matter has not been decided; but in this connexion it might be mentioned that on the day of the great Rumanian earthquake, shocks were felt in Poland and Moscow, the latter said to have been the greatest in the history of the city, also shocks in Santa Barbara (California) and Santiago de Chile.

Aftershocks of the Rumanian earthquake have been violent and frequent. Five of these were at 8.30 a.m., 8.35 a.m. and 9.30 a.m. on November 11 and two shocks on the night of November 12. These were not registered at Kew.

Altogether, the shock constituted one of the great earthquakes of the world, but not one of the greatest. It was the greatest in Rumania since 1802, but was not so great as the Turkish earthquake of December 1939 (NATURE, January 6, 1940).

OBITUARIES

Sir Herbert Wright

THE death of Sir Herbert Wright, which took place recently at Chalfont St. Giles, removes yet another of the prominent figures of the earlier days of the plantation rubber industry. Born in 1874, he was educated at the Royal College of Science, London, and went to Ceylon as scientific assistant to the director of the Royal Botanic Garden, Peradeniya. He later became acting director, and from 1900 until 1906 was controller of the Agricultural Experiment Station in Ceylon.

During this period Wright was actively engaged in the many problems of the rapidly expanding Hevea rubber industry of Ceylon, and soon came to be regarded as one of the leading authorities on the subject. The results of his work and observations on rubber were published from time to time in the *Tropical Agriculturalist* of Ceylon, and in a book entitled "Hevea brasiliensis or Para Rubber, its Botany, Cultivation, Chemistry and Diseases", published in 1905; second and third editions of this work appeared in 1906 and 1908. Another book on rubber, "Rubber Cultivation in the British Empire", from his pen appeared in 1907.

Other tropical crops besides rubber occupied Wright's attention, notably cacao. He published a work on this crop ("Theobroma Cacao or Cocoa") in 1907, in which he presented the results of botanical and experimental work in other countries, and brought them into line with recent research in Ceylon. Citronella and lemon grass were other important Ceylon crops to engage his attention, and with the co-operation of planters he carried out a series of experiments on their growth, oil production, and general behaviour at different altitudes and in response to different soil conditions. He also made contributions to the subject of foliar periodicity in the local flora, and made an intensive study of the genus Diospyros in Ceylon.

From 1907 until 1917 Wright was editor of the *India Rubber Journal*, London, and was associated with various public companies and trusts dealing with tropical agriculture. During 1931–38 he was chairman of the finance committee of the governing body and treasurer of the Imperial College of Science and Technology, South Kensington. He also held other offices in connexion with the Imperial College at different times. He was a fellow of the Linnean Society, and was knighted in 1930.

Mr. E. L. Rhead

By the death on October 19 of Mr. Ezra Lobb Rhead, one of the last remaining representatives of the older school of metallurgists passed away. For forty-five years he lectured on metallurgy and assaying in the Manchester College of Technology, being a representative of the University's Faculty of Technology from its inception in 1904.

He was a teacher with a special gift for, and love of, his profession, who inspired in his pupils a real affection. Of the thousands of students who passed through his department, many have risen to positions of eminence. From all parts of the world his old students corresponded with him, and this continued friendship was a source of great satisfaction to him, especially, perhaps, in the years after his resignation from his lectureship. His interest in the welfare of the teaching profession was particularly marked in his support of the Association of Teachers in Technical Institutions, of which he was the president in three successive years.

Mr. Rhead contributed papers on a wide variety of subjects to the metallurgical societies and institutions in which he was interested. He was the author of several text-books on metallurgy, foundry practice and assaying, and he enjoyed the confidence of manufacturers, to whom his scientific knowledge and practical experience were always available.

Perhaps the outstanding characteristic of Rhead was the affection which he inspired in all those who really knew him, and the great kindness of heart which he invariably showed to those who asked for his help and advice.

F. C. Thompson.

Mr. W. G. Spencer, O.B.E.

Mr. Walter George Spencer, the well-known surgeon and medical historian, died on October 31 after a short illness in Westminster Hospital at the age of eighty-three. He was educated at Weymouth College and St. Bartholomew's Hospital, and qualified in 1885. Throughout his career he was closely connected with Westminster Hospital, of which he was vice-president, as well as lecturer and successively assistant surgeon, surgeon, and consulting surgeon.

He was also a prominent figure at the Royal College of Surgeons, where he was a vice-president, a member of the Court of Examiners, and gave the Arris and Gale, Erasmus Wilson, Bradshaw and Vicary Lectures. During the War of 1914–18 he served as major in the R.A.M.C., and was attached to the Fourth London General Hospital. Besides his clinical activities he took a keen interest in experiments on animals, and contributed two important papers to the *Philosophical Transactions*, the first in 1891 in conjunction with Victor Horsley on "The Changes Produced in the Circulation and Respiration by Increase of the Intracranial Pressure or Tension", and the second in 1894 on "The Effect Produced upon Respiration by Faradic Excitation of the Cerebrum in the Monkey, Dog, Cat and Rabbit". He also delivered a Hunterian Lecture at the Royal College of Surgeons in 1920 on "Animal Experiments and Surgery".

Mr. Spencer did valuable service at the Royal Society of Medicine, where he was president of the Sections of Surgery in 1920–21 and the History of Medicine in 1926–28, as well as honorary librarian in 1916–28. He was also honorary librarian for many years at the British Medical Association, and a member of the Committee of the London Library, at which he was a frequent visitor until shortly before his death. His chief contributions to medical history were his "Westminster Hospital: An Outline of its History" (1924), his collaboration with Sir D'Arcy Power and Prof. G. E. Gask in the revision of Plarr's "Lives of the Fellows of the Royal College of Surgeons of England" (1930), and a translation of Celsus in the Loeb Classical Library (1935-38). He also took an active part in the organization of the second International Congress of the History of Medicine held in London in 1922, when he acted as honorary treasurer and co-editor with the present writer of its proceedings.

J. D. Rolleston.

We regret to announce the following deaths:

Mr. H. H. Baker, president of the New South Wales Branch of the British Astronomical Association, on August 13, aged seventy-two.

Dr. F. W. Edwards, F.R.S., deputy keeper of entomology in the British Museum (Natural History), on November 15, aged fifty-one.

Prof. E. W. MacBride, F.R.S., emeritus professor of zoology in the University of London, on November 17, aged seventy-three.

Dr. S. P. McCallum, University demonstrator in physics, Oxford, on November 16, aged forty-five.

M. Charles Nordman, director of the Paris Observatory since 1920, on November 15, aged fifty-nine.

Prof. Hans Rosenberg, an authority on astronomical photometry, formerly director of the Kiel Observatory and lately director of the Observatory at Istanbul, on July 26, aged sixty-one.

Prof. George Rutledge, professor of mathematics in the Massachusetts Institute of Technology, on September 21, aged fifty-eight years.

NEWS AND VIEWS

Royal Society Medallists

His Majesty the King has been graciously pleased to approve the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year to Prof. P. M. S. Blackett, F.R.S., for his studies of cosmic rays and the showers of particles which they produce, for his share in the discovery of the positive electron, for his work on mesons and many other experimental achievements, and to Dr. F. H. A. Marshall, F.R.S., for his contributions to the physiology of animal reproduction.

The following awards of medals have been made by the President and Council of the Royal Society: Copley Medal to Prof. P. Langevin, For.Mem.R.S., for his pioneer work in the electron theory of magnetism, his fundamental contributions to discharge of electricity in gases and his important work in many branches of theoretical physics; Rumford Medal to Prof. K. M. G. Siegbahn for his pioneer work in high precision X-ray spectroscopy and its applications; Davy Medal to Prof. H. C. Urey for his isolation of deuterium, the heavy hydrogen isotope, and for his work on the use of this and other isotopes in following the detailed course of chemical reactions; Darwin Medal to Prof. J. P. Hill, F.R.S., for his contributions to problems bearing on the interrelationships of the main groups of the Mammalia and on the phylogenetic history of the Primates, a subject with which Charles Darwin himself was so much concerned; Sylvester Medal to Prof. G. H. Hardy, F.R.S., for his important contributions to many branches of pure mathematics; Hughes Medal to Prof. A. H. Compton for his discovery of the Compton effect, and for his work on cosmic rays.

The Dublin Institute for Advanced Studies

In Dublin, by an act of the Oireachtas, the Dublin Institute for Advanced Studies was founded in October. For the time being it consists of two constituent schools, the School of Celtic Studies and the School of Theoretical Physics. The general government of the Institute is entrusted to a Council, to which Rev. P. Browne (chairman), Dr. R. I. Best, Prof. D. A. Binchy, Prof. F. E. W. Hackett, Prof. E. Schrödinger were appointed by the President of Eire, whilst the President of University College, Dublin (Prof. A. W. Conway), the Provost of Trinity College, Dublin (Dr. W. E. Thrift) and the President of the Royal Irish Academy (Eoin MacNeill) are members *ex officio*.

The Institute will provide facilities for advanced studies and research in special branches of knowledge and for the publication of the results of such studies, irrespective of whether they have originated from the Institute or not. In particular, the scope of the School of Theoretical Physics is described as the investigation of the mathematical principles of natural philosophy and their application to the sciences in which they obtain. Both the training of advanced students in methods of original research and the provision of research facilities for professors and lecturers on leave of absence from their academic duties will be included. Seminars and lectures on topics which lie on the frontiers of knowledge are to be held. Financial aid for producing and publishing works within the scope of the School (but not necessarily originating from it) is envisaged. Admission to the Schools is granted by the Council of the Institute, to which applications, or inquiries of any kind, should be directed (64–65, Merrion Square, Dublin). Moderate fees will be charged, but a limited number of scholarships, including a substantial contribution to maintenance, are available. The first senior professor appointed to the School of Theoretical Physics is Prof. E. Schrödinger, formerly of the University of Graz. Apart from the Council of the Institute mentioned above, each School has a Governing Board. This Board, for the School of Theoretical Physics, includes: Prof. A. W. Conway (chairman), Prof. F. E. W. Hackett, Prof. A. J. M'Connell, Prof. W. H. McCrea (Belfast), Prof. A. O'Rahilly (Cork), Prof. E. T. Whittaker (Edinburgh).

Mr. Roosevelt and the "New Order"

With remarkable propriety, the occasion for Mr. Roosevelt's first public address after the presidential election was Armistice Day, November 11, when he spoke at the tomb of the Unknown Warrior at Arlington Cemetery. Equally appropriate was his choice of a theme—a review of the progress of democracy since the Declaration of Independence, when, as he said, a New Order came into being. In showing how the gospel of democracy has been carried among peoples, great and small, by the Americas, "all of the Americas" and the British Isles with them, the President brought the War of 1914–18 into a truer perspective, not as a useless sacrifice, but as a phase in the resistance to the doctrine that might is right which then made a definite effort to destroy this New Order after its relatively short trial. The struggle of 1914–18, Mr. Roosevelt continued, preserved the New Order of the ages for at least a generation; and had the Axis of 1918 been successful over the associated nations, resistance on behalf of democracy in 1940 would have been impossible. At the same time, he recognized and impressed upon his hearers the need for great flexibility in the methods of democracy. Certain facts of 1940 did not exist in 1918. There is need for the elimination of aggressive armaments, the breaking down of barriers in a more closely knitted world and a need for restoring honour in the written and spoken word. To attain these purposes the processes of democracy must be much improved.

In thus foreshadowing in general terms the process of future growth in the democratic idea, Mr. Roosevelt was contemplating democracy as of the spirit, as a way of life and not merely as a political system, contrasting it with another 'New Order' of which much has been heard recently. Of the methods of this latter no graver indictment could be set forth than in the preamble to the proposed post-War agreement of co-operation between Poland and Czechoslovakia, in which it is shown that among its other crimes the Nazi regime is exterminating the intellectual class and all manifestations of cultural life, while despoiling these countries of their treasures of art and science and persecuting all religious beliefs. Against the spirit of these and other Nazi crimes "unparalleled in all human history", the agreement between Poland and Czechoslovakia aims at setting up an association "which would become a new order in Central Europe and a guarantee of its stability", no less than the 'New Order' of the President of the United States, based upon "respect for the freedom of nations, the principles of democracy and the dignity of man".

Photographic Exhibitions of Indian Art and Religion

The exhibition of photographs illustrating Indian art and religion at the Imperial Institute, South Kensington, London, which was opened by Mr. L. S. Amery, H.M. Secretary of State for India, on November 13, will repay careful study. It does, in fact, convey a clearer view of Indian genius and mentality than many collections of a more spectacular and imposing character. As Mr. Amery pointed out in declaring the exhibition open, just as Europe in the Middle Ages had embodied its ideas and ideals in the cathedral, so in India Hinduism had attained the highest artistic expression of its religious conceptions in the temple; and ornamentation and decoration were the natural media in which both the artistic and the mental perceptions of India were illustrated. In order to understand India, Mr. Amery went on to say, it is necessary to have a perception of her architecture, her sculpture and her temple symbolism. The selection and grouping of the photographs in this exhibition, as well as the carefully prepared captions, are such as to give the visitor who examines them with attention, even if his previous knowledge of Indian art be slight, something more than a superficial view of the three aspects of Indian culture to which Mr. Amery referred; moreover, he will be impressed by the subtlety which pervades all Indian religious art, whether Hindu, Buddhist or Jain, and makes it in virtue of its all-pervading symbolism so remarkable a vehicle for conveying theological and philosophical concepts and ideas.

The arrangements for the exhibition have been made by the India Society and the Warburg Institute. The photographs, which attain a high standard of technical skill, are the work of Dr. Stella Kramritsch, lecturer on Indian art in the University of Calcutta. They illustrate developments in Hindu temple architecture and religious art, inclusive of such reform movements as Buddhism and Jainism from 200 B.C. to A.D. 1700. Broadly speaking, the arrangement is chronological; but since, as already indicated, interest centres upon religious concepts rather than æsthetic principles and achievement, though the latter are by no means passed over, examples are grouped and classified to illustrate these concepts. Naturally, in the early phases the Indianization of classical Greek art in Northern India figures prominently, while the group covering the setting of the temple demonstrates characteristic examples of the geographical environment as well as external form. Attention may be directed in particular, however, to the illustrations of the growth and meaning of symbolism, as well as of the worship of the symbol, and its plan in Indian religion and philosophy, the most striking example of this to the Western mode of thought being the manner in which the rhythms of the body as in dancing, or its functions as in sexual relations, are made to express a state of mind on a cosmic principle.

Antiseptics in War-Time Surgery

The winter session of the Pharmaceutical Society's evening meetings was inaugurated on November 14 by Prof. A. Fleming, professor of bacteriology in the University of London, who delivered a lecture on "Antiseptics in War-Time Surgery". He said that in the present War surgeons should be able to undertake their work more efficiently than they were in 1914 in view of the chemical antiseptics which are now available but were then lacking. Thus the present situation in respect of the treatment of war wounds is infinitely more satisfactory than it was in the War of 1914–18. The antiseptics in use in 1914 have since been shown to be of little value for use in war-time surgery. Carbolic acid, for example, is effective when used otherwise than in connexion with the human body, but inside the body its lack of value is shown by the diminution of its efficiency with increasing concentrations, this being due to its action in destroying the leucocytes. Consequently carbolic acid is not of any great use as an antiseptic in the treatment of wounds.

Prof. Fleming also pointed out that the dyes are of little value as they are absorbed by the cotton wool used in dressing the wounds. Regarding antiseptics belonging to the sulphonamide group, he gave a warning against placing too much faith in them. They are not, he said, general antiseptics but are specific to certain bacteria; further, the action of these antiseptics is neutralized by chemicals, pus and dead bacteria and they are therefore of little value in the treatment of seriously septic wounds, in which pus and bacteria were inevitably present. The virtue of this new group of antiseptics is in their high solubility; they dissolve to form high concentrations in the wound. The sulphonamides are of great value in the treatment of fresh wounds where pus and bacteria are absent, since they inhibit the growth of certain important bacteria, and there is nothing in the fresh wound to inhibit the action of the sulphonamide.

The Albanian Fauna

The extensive fighting in Albania is in a region rich in natural history interest, particularly ornithology, where Hugh Whistler, Dr. Ticehurst, Prof. P. A. Buxton, W. E. Clyde Todd and Ludwig von Fuehrer have made collections in recent years (*Ibis*, 1929, 1932, 1936) and 272 bird forms have been listed. Nesting chaffinches examined from Albania have been found to be *Fringilla cœlebs balearica* and not the typical form, but there is much of British interest in the bird life. Jays are fairly common in the valleys, up to 1,200 ft., and they have been seen at 1,500 ft. in the Logra Forest on the Acroceraunian Mountains. Magpies (*Corvus cernix sardonius* and *Corvus monedula soemmerungii*) are not so common as formerly reported, and not usually above 2,500 ft. Orioles are common. In his expeditions from Valona to the Acroceraunian Range in 1935, Whistler for the first time verified the great black woodpecker occurring in the country (*Ibis*, April 1936), while birds collected by Ludwig von Fuehrer in 1932 are now in the Carnegie Museum at Pittsburgh. The Spanish sparrow and blackbird are widespread, though local, and there are tree-creepers, marsh-tits, rock-nuthatches, numerous Spanish wheatears, and the robin nesting at 2,500 ft. in the Logra Forests. The imperial eagle nests in open country, the goshawk in the Jinokastro valley, and there are hobbies, peregrines, sea-eagles and harriers; white storks inhabit the ruined towers in summer and a colony of pygmy cormorants nests in the middle of the Lake Terbuf. Colonies of egret nest on the marshes at Durazzo, Valona, etc., along with garganey, pintail, bitterns, purple herons, Kentish plover, pelicans, and yellow-legged herring-gulls, and the adjoining woods have six species of woodpecker, hazel grouse, capercailzie, Cetti's warbler and subalpine warblers. The alpine accentor and alpine chough inhabit the mountains, the thick-billed reed-bunting, bearded reedling and penduline tit the plains, the dipper is common at the mountain streams, the crested tit in the fir forests and the red-rumped swallow in many districts.

Leeds University Union's Loan

The University Union, comprising the whole body of students of the University of Leeds, has decided to lend to the Government free of interest the sum of £1,000. In consequence of the postponement of the construction of the proposed swimming bath and of the extension of the existing gymnasium, the Union found itself with a balance of money which had been set aside for use in connexion with those new developments. In these circumstances the Union Committee felt that this money might appropriately be placed in the hands of the Government until such time as it can be devoted to its original purpose, that is until building work again becomes possible after the War. The University authorities approved of the Committee's proposal and of its wish to forego interest on the loan. The Union has also invested the sum of £400 in Defence Bonds.

The New "Nomenclator Zoologicus"

It is satisfactory to be able to report that the publication of the "Nomenclator Zoologicus", an announcement respecting which was made in Nature of February 25, 1939, p. 326, has now been completed. Moreover, in spite of the inevitable difficulties that have arisen out of the conditions under which the later volumes have been produced, the final one has appeared nearly two months in advance of schedule. The work, which covers the literature from 1758 to the end of 1935, is contained in four volumes, the last of which includes a supplementary list of addenda and corrigenda. It contains in all about 227,000 entries, including cross-references, though it is probable that these do not represent more than about 190,000 genera or subgenera treated as distinct by present-day systematists. Of these, the Arthropoda represent more than 70 per cent of the whole, the Insecta alone representing 50 per cent.

In the preparation of the work, the editor, Dr. S. A. Neave, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7, has had the ungrudging assistance, not only of most of the staff of the British Museum (Natural History), but also of numerous other zoologists both in Great Britain and abroad. The work is published for the proprietors by the Zoological Society of London, which has borne the main cost of compilation. Thanks to grants from outside sources, including the Carnegie Corporation of New York, it was found possible to issue the complete work of more than 3,800 pages to original subscribers at the low price of six guineas; but it has now been found necessary to raise this to ten guineas.

Luigi Luciani

Prof. Luigi Luciani, the celebrated Italian physiologist, was born at Ascoli Piceno on November 23, 1840. He received his medical education at Bologna and Naples, and qualified at Bologna in 1868. After acting as assistant to Vella in the Institute of Physiology at Bologna he spent nearly two years in the corresponding institute at Leipzig under Ludwig. On his return to Bologna he became lecturer in experimental pathology and also devoted himself to the study of the physiology of respiration. In 1875 he was appointed professor of physiology at Parma, where he remained for five years. In 1880 he succeeded Giannozzi in the corresponding chair at Sienna, and shortly afterwards became professor of comparative physiology at Florence, where he remained from 1880 until 1892. During this period his most important work, namely, that on the cerebellum and fasting, was carried out. Finally, he occupied the chair of physiology at Rome, which he held until his retirement in 1917. His original work consisted mainly of his studies on the physiology of the cardiovascular system, the cerebral cortex and cerebellum muscular movements and fasting, the last being carried out on Succi, the professional fasting man. He was also interested in phonetics, psychology, and the history of medicine. His most important publications were those on the functional localization of the cerebellum (1885), the physiology of fasting (1889), and human physiology (1898–1903), the latter having been translated into English, German and Spanish. He died on June 23, 1919.

Louis Stromeyer Little

Mr. Louis Stromeyer Little, an eminent surgeon and astronomer, was born in London on November 23, 1840, the third son of Dr. William Little, the orthopædist who gave his name to cerebral diplegia. He was educated at St. Paul's School and at Kiel and Hanover. He qualified M.R.C.S. in 1862 and the same year became assistant surgeon at the London Hospital, and later was appointed to the National Orthopædic Hospital and St. Mary's Hospital for Women and Children. In 1866, when an epidemic of Asiatic cholera occurred in the East End of London and application was made to the London Hospital for assistance, he took an active and successful part in its treatment by intravenous injection of saline solutions. On the outbreak of the Schleswig-Holstein War in 1864, Little first joined the Prussians, but afterwards joined the Danish forces. In 1869 he went to Shanghai where he soon acquired the best medical practice in the Far East. He also developed the knowledge of astronomy which he had acquired in London to a remarkable extent, and not only built an observatory at Shanghai, but also established the first telegraphic longitude observed in China by means of telegraphic signals with Nagasaki, 600 miles away on the opposite shore of the Yellow Sea. This achievement gained him the fellowship of the Royal Astronomical Society in 1877. After residence in China for nearly thirty years he returned to England via South Africa, where he was awarded the South African Medal for his services in the Boer War. He died on October 4, 1911.

Prof. Carlo Giacomini

Prof. Carlo Giacomini, an eminent Italian anatomist and anthropologist, was born at Sale near Alessandria on November 25, 1840. He obtained his medical qualification in 1864 at Turin, where he divided his time between anatomy and clinical medicine until 1880, when he was appointed professor of anatomy and gained a high reputation as a teacher. The classical researches with which he is connected are those on the anatomy and teratology of the brain, his method of preservation of the cerebral convolutions, the anatomy of the negro, and investigations on anomalies of development of the human embryo. He was also co-editor of *L'Osservatore*. The Museum of Anatomy at Turin owes much to him for its collections. He died at Turin on July 25, 1892.

The Newcomen Society

On November 13, at the Iron and Steel Institute, the Newcomen Society held its annual general meeting, and then listened to the reading of two papers. In the report of the Council for the year 1939–40, it was stated that 322 new members have been elected and the membership now stands at 1,512. The majority of the new members are citizens of the United States. Though owing to the stress of war two London meetings were cancelled, a good series of papers were read and many other activities were carried on. The Council sent a chaplet to Handsworth Church on November 15, 1939, to mark the centenary of the death of William Murdoch, and joint action was taken with the Smeatonian Society to place a tablet in the chambers in Gray's Inn occupied by Smeaton during 1783–1793; but the completion of this memorial has had to be deferred. Among the members whose death has been recorded during the year was Mr. L. F. Loree, who is regarded as the founder of the Society in the United States. After the report had been passed, the meeting re-elected Col. C. E. Davies, of New York, for a second year as president. The papers read were respectively by Mr. E. W. Hulme and Dr. H. W. Dickinson, the latter dealing with the work of Henry Cort, the inventor of the puddling process for the manufacture of wrought iron, while Mr. Hulme's paper was entitled "Prehistoric and Primitive Iron Smelting: Part 2, The Crucible Processes of the East". It has been decided owing to the conditions prevailing that no meetings will be held in December and January, but if possible a resumption will be made in February.

Eradication of Bracken

Bracken has become an increasing menace in recent years, and vigorous efforts are being made to find cheap and efficient means for its eradication. Although systematic cutting or crushing can be entirely successful, the process is slow, about eight cuttings at the rate of two a year being required. A more rapid method of destruction is achieved by either broadcasting or spraying with sodium chlorate, but as 2 cwt. per acre is needed the cost (approximately £4 an acre) is prohibitive. Chlorate, however, is much more toxic when introduced directly into the plant, and Dr. G. H. Bates has devised a mechanical method whereby the chemical can be applied to the cut end of the bracken frond. The chlorate added in this way rapidly kills the aerial portion, and ultimately destroys the underground rhizomes of the plant; only 15–20 lb. of the chemical is required per acre.

The apparatus and method of use are described in Bulletin 14, Rubber and Agriculture Series, published by the British Rubber Publicity Association, 19 Fenchurch Street, London. Bracken crushers or cutting machines which break or bend the stem are not suited to this direct application technique, as unbroken continuity of the vessels is essential for proper penetration of the chlorate; but with hand scythes or machines with reciprocating knives it works well. A small attachment strapped to the worker's belt has been devised for use with a hand scythe. It does not weigh more than 10 lb. when filled with solution and needs only be replenished about four times daily. A rubber tube serves as a feed on to a sponge rubber pad, backed by a meta plate which is attached to the scythe blade. The rate of flow can be controlled. A somewhat similar device which has proved very efficient has also been constructed for attachment to a motor-scythe, and no special skill is required in its use. Experimental work on the subject is being continued, and it seems possible that given good weather conditions, complete eradiction of bracken may ultimately be obtained after a single cut.

Rationing of Manufacturers' Supplies

It has recently been suggested to us that in placing orders for material or apparatus, an authority for the order should always be quoted in order to secure release of material. In an article on "The Manufacturers' Order Book" by "Sala" which appears in the *Electrical Review* of November 8, the whole problem raised by questions of priority is discussed. Almost every manufacturer of materials required in the war effort has to decide whether to refuse orders for the time being or to limit the acceptance of orders so as to bring them into line with his estimated output. The manufacturer can obtain but little guidance from his customers as to the urgency of their requirements, for each will rightly demand preference in view of the material being required for urgent Government work. It may also happen that material ordered through the usual trade channels is required for some vitally important part of the war effort and demands priority over orders received direct from Government departments. One way out of the difficulty is for the manufacturer to see that each customer will get a portion of his requirements. This rationing of supplies rarely solves the difficulties. The manufacturer realizes the inadvisability of refusing orders particularly as he generally has no means of authenticating their vital importance in comparison with the uncompleted priority orders still on his books. He feels that the responsibility of limiting or reducing the amounts specified in a consumer's order should not be left to the manufacturer.

Mosquito Control in Great Britain

The Ministry of Health has recently published a "Memorandum on Measures for the Control of Mosquito Nuisances in Great Britain" (No. 238, Medicine, 1940) by Lieut.-Col. J. A. Sinton and Mr. P. G. Shute. While mosquitoes may carry malaria in certain circumstances in Britain, as happened during and after the War of 1914–18, it is mainly because of the nuisance caused by the bites that anti-mosquito measures are undertaken in Great Britain. Of the 29 recorded species, eight are so rare or so seldom bite man that they may be considered unimportant from the public health point of view. *Anopheles maculipennis* is the potential carrier of malaria and during the past twenty-five years more than 500 cases of the disease have been proved to have been locally contracted in almost every instance through its agency. The habits, economy, and means of control of this and other British mosquitoes are dealt with in this memorandum. The information given is up to date and has obviously been carefully collated. If anti-mosquito measures are to be applied effectively and economically the species concerned must be identified and its habits taken into account. Specimens are identified free of charge at the Malaria Laboratory of the Ministry of Health or at the British Museum (Natural History). Once a given species is named the advice given for its control may be followed. The memorandum, it may be added, is to be obtained from H.M. Stationery Office or through any bookseller, price 6*d*. net.

A Parachute Fishing Net

Dr. J. F. G. Wheeler, director of the Biological Station at Bermuda, has succeeded in designing a workable net in the form of a parachute for catching small deep-sea planktonic organisms. The novel idea of a fishing net without a towing line is adapted from the method used by Prof. Maurice Ewing in his work on the sub-sedimentary rocks beneath the sea. The net fishes upside down. At the top is a fine mesh followed by a wider weave net; it then broadens out to a canvas-like material which has metal 'eyes' punctured into the bottom. From these 'eyes' are attached ropes or bridles. These come down in a V fashion to a small cord to which is attached a wire receptacle in which is placed a large lump of rock salt. Beneath this are suspended two weights. At the top of the net, and inside it, is a funnel-like pipe leading into a bucket. Affixed to the top of the bucket are a float (a can filled with petrol) and a flag.

The net is nine feet three inches across its mouth and nearly thirty feet long. The two concrete weights total 138 lb. The apparatus is easily thrown into the sea. On its downward journey the net swells out and opens in a parachute-like form, retaining its shape on its descent. It catches as it goes down the minute plankton which enters the mouth and passes into the bucket through the funnel. The net touches the bottom. The salt has by this time dissolved (the requisite amount having been roughly calculated) and the weights are released. The closed parachute is then brought to the surface by the float. The net was successfully used at a depth of more than 1,000 fathoms. Its advantages over a tow-net are that it can be handled easily by a small crew in calm weather, and can be left to itself while the boat is elsewhere. Also that the specimens are in better condition when brought to the surface.

The American Museum of Natural History

The Americas for the moment are fortunate in being so far removed from the theatre of war as to be able to continue scientific investigation in the field, even though it be only on a restricted scale. During the past summer, the American Museum of Natural History has sent expeditions for zoological and palæontological research to Alaska, Kansas, Texas and Dakota (*Science*, August 16, 1940). The expedition under Dr. Walter Grainger, curator of palæontology in the Museum, which is exploring the Big Badlands of South Dakota for fossils of the three-toed horse, the pygmy rhinoceros, and cats, especially the sabre-toothed tiger, is accompanied by

Junius Bird, assistant in the Museum's Department of Anthropology. Mr. Bird will conduct excavations in the recent deposits overlying the fossil beds, in which have been found evidence of early human occupation, such as chalcedony tools, including scrapers and knives, and sherds of a black pottery.

An expedition under Dr. Grace Ramsay Fisher, of the Department of Education of the Museum, has been engaged in recording the life and work of Indian artist craftsmen in Mexico, a field in which surviving primitive conditions still afford a profitable field of research and recordings. Collections will illustrate typical examples of representative native craftsmanship in weaving wool, cotton, and plant fibres, embroidery and beading, pottery, showing the regional designs, leather, metal and lacquer work, masks, musical instruments and toys. The areas covered were central, south-east and south-west Mexico, and coloured motion pictures illustrate the life of their villages. This material ultimately will be circulated by the Department of Education for use in schools and other educational institutions.

Leprosy in Brittany

In his inaugural thesis (*Thèse de Paris*, 1940, No. 229), Dr. Y. M. Marhic states that leprosy disappeared from Brittany at the end of the seventeenth century, and no further mention was made of its occurrence there until 1892, when Zambaco Pacha, during a visit to the province, rediscovered the disease. Since then it has been the custom to describe Brittany as a leper country like the Mediterranean coast. Zambaco Pacha, however, found only two cases of leprosy in Brittany which were not indigenous, and since then only five cases in all have been described in Brittany in the course of forty-seven years, namely, one by Jeanselme (probably indigenous), one by Loussot-Netter (indigenous), three by Gouin, two of which showed *B. lepræ*, and two doubtful cases by Laferre, which were probably examples of leprosy without bacilli. Marhic therefore comes to the conclusion that leprosy does not appear to be more frequent in Brittany than in the other French provinces.

Jute-Growing in the U.S.S.R.

The All-Union Institute of Plant Cultivation of the U.S.S.R. has for the past thirteen years been carrying on experiments in the cultivation of jute, and has proved that this important industrial crop can be grown successfully in the Soviet Union. From among 150 varieties imported from India and various other tropical and sub-tropical countries and planted by the Institute in certain districts of Transcaucasia and Central Asia, the species *Corchorus capsularis* and *Corchorus olitorius* have been selected. These plants yield 13–25 per cent fibre, and produce a crop of seeds, which will make it possible to cultivate jute in the U.S.S.R. on an industrial scale. At present the Institute is endeavouring to acclimatize species and varieties with a greater yield.

Announcements

Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, has been awarded the George Robert White Medal of the Massachusetts Horticultural Society.

Sir Arthur MacNalty, chief medical officer of the Ministry of Health and of the Board of Education, is retiring on reaching the age limit. The Minister of Health and the President of the Board of Education have respectively appointed Sir Wilson Jameson to be chief medical officer of the Ministry and the Board. Sir Wilson Jameson is relinquishing the post of medical adviser to the Secretary of State for the Colonies, from which in the circumstances the Secretary of State did not feel that he could refuse to release him. He is also relinquishing the post of dean of the London School of Hygiene and Tropical Medicine and professor of public health in the University of London.

The Ministry of Food announces that the Flour (Vitaminization) Advisory Committee, which has recently been appointed, will have the assistance in its official capacities of Prof. D. M. S. Watson, F.R.S., of the Scientific Sub-Committee of the Food Policy Committee of the Cabinet, of Mr. P. N. R. Butcher, of the Ministry of Health, and of the following officers of the Ministry of Food: Sir Norman Vernon (director of flour milling), Prof. J. C. Drummond (scientific adviser), Dr. T. Moran (deputy scientific adviser), and Mr. J. H. Pillman (manager for imported flour).

The following appointments have recently been made in the Colonial Service: P. R. Akehurst, agricultural officer, Nyasaland; L. H. Browne, agricultural officer, Nigeria; J. W. D. Goodban, agricultural officer, Nigeria; A. P. MacWilliam, agricultural officer, Trinidad; D. B. Murray, agricultural officer, Nigeria; P. Paine, agricultural officer, Nigeria; M. F. H. Selby, botanist, Nigeria; N. Harris, geologist, Uganda.

Dr. R. Lessing, of 50 Queen Anne's Gate, London, S.W.1, has a complete set of unbound copies of Nature dating from 1918 up to the current issue. He is prepared to present these to any person, school or institute. Application should be made to Dr. Lessing direct.

The Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered by Mr. H. J. E. Peake at 2.30 p.m. on November 26, at the rooms of the Institute, 21 Bedford Square, London, W.C.1. The subject of the lecture will be "The Study of Prehistoric Times".

The second of the Cantor lectures of the Royal Society of Arts will be delivered by Prof. S. J. Davies at 1.45 p.m. on November 25, at the Society's rooms, John Adam Street, Adelphi, London, W.C.2. The subject of the lecture will be "Recent Developments in Internal Combustion Engines".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Energy of Aliphatic Carbon Links

THE information about the strength of carbon links, obtainable from thermo-chemical measurements on organic substances, is of an indirect nature. If R is an alkyl (or other) radical, we can, from the heats of formation of RH, RX (and XY, YH), derive the thermal effect Q of a substitution of the type

$$RH + XY = RX + YH + Q;$$

and for a series of different radicals R these heats vary as the substitution heats in the corresponding reactions of the type

$$RH + X = RX + \dot{H} + Q'.$$

For the magnitudes of Q' listed below, the heats of the reactions $X + Y = XY$ and $\dot{H} + Y = YH$ are required, and have been taken from the compilation of Bichowsky and Rossini[1], with the exception of $H + OH = H_2O$ taken as + 115 Cal.; the differences in Q' between different radicals R are, however, independent of these further assumptions and depend only on differences in Q.

TABLE 1. SUBSTITUTION HEATS, Q'. (EXOTHERMIC HEATS TAKEN AS POSITIVE)

	$X = CH_3$	$X = Br$	$X = OH$	$X = \beta\cdot$
CH_3H	−15·4	(−33·9)	−16·0	—
C_2H_5H	−13·0	−30·5	−10·2	−68·0
n-C_3H_7H	−12·7	−30·1	− 8·8	−67·5
sec-C_2H_7H	−10·8	−27·9	− 4·5*	−66·0
tert.-C_4H_9H	−10·0	−25·9	− 0·6*	−64·6

In Table 1 the data for $X = CH_3$ and OH come from the papers of Rossini[2]. β· signifies a free valence in the β position, released by the removal of an H-atom. "Substitution" by β·, e.g. for $R\text{-}CH_2\text{-}CH_2\cdot$, would consist in $R\text{-}\overset{\alpha}{C}H_2\text{-}\overset{\beta}{C}H_2\cdot = R\text{-}CH = CH_2 + H$. Measurements by Kistiakowsky and his school[3] were used for the columns Br and β·, following the assumption substantiated by them that heats of addition on two neighbouring carbon atoms are independent. The substitution heat of Br on CH_4 was obtained by extrapolating the four figures below it, relating their trend to that of the two neighbouring sequences. In the CH_3 column the C–H bond strength in CH_4, which comes in as an additive constant, is given the value 103·6 deduced later in this letter.

TABLE 2. BOND ENERGIES.

	C–I	C–I (smoothed)	C–Br	C–H	$C\text{–}CH_3$	C–OH	α–β
CH_3–	53–54	55·0	69·7	103·6	88·2	87·6	—
C_2H_5–	52·2	51·2	65·9	96·4	83·4	86·2	56·6
nC_3H_7–	50·0	50·7	65·5	95·5	82·8	86·7	—
sec. C_3H_7–	—	(48·4)	63·1	91·6	80·2	86·5*	53·0
tert. C_4H_9–	45·1	46·3	61·0	86·9	76·9	87·6*	51·4

Table 2 shows the results of a combination of these Q' values with measured bond energies of C–I [4]. The 'smoothed' column is obtained by plotting the measured values against the Q' for RBr; the *sec.*-propyl value being thus interpolated. (Plotting the measured values against the velocity constants of the gas reaction $Na + ClR$ also leads to 55·0 for the CH_3–I bond.) The difference between R-Br and R–I bond strengths was assumed independent of R; this view is supported by unpublished measurements of Dr. G. N. Burkhardt on the equilibria $RCl + I' \rightleftharpoons RI + Cl'$ for various alkyl radicals. This difference was evaluated as 14·7 (± 0·6) from data quoted by Conn, Kistiakowsky and Smith[3] on the heats of addition of hydrogen bromide and iodide respectively to ethylene and isobutene, and from the heats of formation of methyl bromide and iodide, ethyl bromide and iodide, and methylene bromide and iodide given by Bichowsky and Rossini[1]. The last column, α − β, signifies the energy of the second valence in a double bond linked to the α-carbon of radical R (from which a β-hydrogen has been removed).

The most interesting result of this scheme seems to be the uniform trend of all the bond strengths (C–OH being almost constant), while C–H shows the strongest variations. This was not formerly expected; perhaps because it involves changes in the C–H bond energy on a much greater scale than hitherto thought likely. We shall attempt, together with Prof. M. G. Evans, in a forthcoming publication, a theory of carbon bonds in which the uneven rate of variation in the vertical columns of Table 2 is related to differences in the size and steepness of gradation of the ionic terms of the bond energies in question, as indicated by the parallel trend of increasing dipole moments in the R-halogen bonds.

E. C. BAUGHAN.
M. POLANYI.

University,
Manchester.

---

* The first comes from the difference in heats of combustion of *n* and *iso*propyl alcohols given by Parks and Huffman ("Free Energies of Some Organic Compounds" New York, 1932), combined with the heat of formation of *n*-propyl alcohol from propane (Rossini); the second from the difference in the heats of combustion of normal and tertiary butyl alcohols (Parks and Huffman) combined with Knowlton and Rossini's results for the difference in the heat content of *n*-pentane and *iso*pentane. Corrections for evaporation heats are made according to H. C. Brown (*J. Chem. Soc.*, 990; 1903). These results are probably uncertain to ± 2 Cal.

Q' for CH_3 and OH refers to 25°C., the Br and β· data to 82°C., and the C–I bond-strengths were determined between 400° and 500°C.

[1] Bichowsky and Rossini, "Thermochemistry of Chemical Substances" (New York, 1936).

[2] Rossini, F. D., *Bull. Bur. Standards J. Research.*, **13**, 29, 189 (1934); Knowlton, J. W., and Rossini, F. D., *ibid.*, **22**, 115 (1939).

[3] *J. Amer. Chem. Soc.*, **60**, 2764 (1938) and earlier papers referred to there.

[4] Butler, E. T., and Polanyi, M., NATURE, **145**, 129 (1940). Some data are from unpublished material.

Complex Rotatory Dispersion of Optically Active Tetrahydrofuryl-2-carbinol

THE dextro- and the lævo-rotatory forms of tetrahydrofuryl-2-carbinol, obtained by crystallization of the brucine salt of its hydrogen phthalic ester, exhibit complex rotatory dispersion, the carbinol obtained from the (−) hydrogen phthalic ester having

$$\alpha^{20}_{6708}\ -2{\cdot}23^\circ,\quad \alpha^{20}_{6438}\ -2{\cdot}36^\circ,\quad \alpha^{20}_{4603}\ +0{\cdot}56^\circ,$$

$$\alpha^{20}_{4032}\ +5{\cdot}69^\circ,\ \alpha^{20}_{3392}\ +28{\cdot}4^\circ,\ (l = 1).$$

Determinations of specific rotatory power of the carbinol at increasing dilutions in aqueous solution give a family of curves of which the inflexions, maxima and reversals of sign are displaced towards the ultraviolet as the dilution increases. (This effect has been observed with tartaric acid by Lowry and Austin[1].)

A similar family of curves is given by the specific rotatory powers of the carbinol dissolved in the simple aliphatic alcohols (5 per cent solution), the characteristic features of the curves being moved towards the longer wave-lengths as the molecular weight of the solvent alcohol is increased.

In dioxan solution the specific rotatory power in the visible spectrum is practically independent of concentration. The rotatory power of the carbinol is not peculiarly sensitive to temperature changes and the rotatory dispersion of its esters is simple.

A more detailed description will be published elsewhere when circumstances permit. We have to thank Dr. C. B. Allsopp, of Cambridge, for determinations of rotatory power in the ultra-violet.

M. P. BALFE.
M. IRWIN.
J. KENYON.

Chemistry Department,
Battersea Polytechnic,
London, S.W.11.
Oct. 17.

---

[1] *Phil. Trans.*, A, **222**, 249 (1922).

Classical and Quantum Reflections of X-Rays in Crystals

IT appears desirable that we reply, though very briefly, to the comments that have appeared in NATURE[1,2] on our first note[3] on this subject and which were evidently written before our second and supplementary note[4] had been published. Our purpose in these communications was very definite, namely, to indicate it as a necessary consequence of classical optics and of quantum mechanics that there should be two types of X-ray reflection in crystals, due respectively to static and to dynamic stratifications of electron density; in the language of quantum mechanics, these correspond respectively to an elastic collision of the photon with the crystal lattice and to an inelastic one in which part of the energy of the photon is transferred to the crystal as an optical vibration of its lattice structure.

From the optical point of view, the two types of reflections are on a very similar footing; we have respectively $2\,d \sin \theta = n\lambda$ and $2\,d^* \sin \psi = n\lambda$. Here $\psi = \frac{1}{2}(\theta + \varphi)$, where θ and φ are the glancing angles of incidence and quantum reflection measured with reference to the crystal planes under consideration. The dynamic spacing d^* and the corresponding static spacing d are connected by the vector relation $\overrightarrow{1/d^*} = \overrightarrow{1/d} + \overrightarrow{1/\Delta}$, where Δ is the phase-wave-length of the lattice vibration. The scalar magnitudes of d and d^* become indistinguishable when Δ is infinite or when, though finite, it is transverse to d. The law of quantum reflection then assumes the very simple symmetric form $2\,d \sin \frac{1}{2}(\theta + \varphi) = n\lambda$. More generally, $d^* = d$ when $\theta = \varphi$, but deviates in one direction or the other from it according as θ is greater than or less than φ.

For the experimental proof of our thesis, it is necessary that new reflections should be observed which are not greatly inferior in definition to the usual Laue spots, and in which reflections corresponding to different wave-lengths appear clearly resolved from each other as demanded by the Bragg formula. These features are precisely those which were observed and reported upon by us. The streaks and diffuse spots in Laue patterns noticed by earlier workers were not particularly relevant to our thesis, especially in view of the very varied and entirely different but apparently quite plausible explanations of them which had been put forward in the literature. It can, we believe, scarcely be contended that these earlier observations are, in any real sense, an anticipation of our fundamental observations and conclusions.

We have observed that the quantum reflections given by diamond are sharply defined over a wide range of incidences and continue to be visible even when the crystal is cooled down to liquid air temperatures. These facts wholly exclude any explanation of these reflections in the terms of the diffuse thermal scattering of X-rays (Faxen[5], Zachariasen[6]). Measurements made by us over a wide range of incidences also show that neither in the case of ionic crystals nor in the case of diamond are the observed positions of the reflections in agreement with a formula of the Faxen-Zachariasen type.

C. V. RAMAN.
P. NILAKANTAN.

Department of Physics,
Indian Institute of Science,
Bangalore.
Sept. 20.

---

[1] Knaggs, Lonsdale, Müller and Ubbelohde, NATURE, **145**, 821 (1940).

[2] Zachariasen, NATURE, **145**, 1019 (1940).

[3] Raman and Nilakantan, NATURE, **145**, 667 (1940).

[4] Raman and Nilakantan, NATURE, **145**, 860 (1940).

[5] Faxen, *Z. Phys.*, **17**, 266 (1923).

[6] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).

Isolation of Acetylsulphathiazole from Human and Rabbit Urines following Administration of *M.* and *B.* 760

SEVERAL reports have been made in the American clinical literature during the early part of this year of concretions in the urinary system and of crystals in the urine of humans treated with sulphathiazole (*M.* and *B.* 760). In some instances[1,2] these concretions and crystals are merely referred to as a derivative or a conjugated form of sulphathiazole; in other instances[3,4], however, the statement is made that the crystals are acetylsulphathiazole, although no chemical evidence for their identity is given.

During work in progress in this laboratory on the fate of sulphonamide drugs *in vivo*, we have had occasion to examine crystals from both human and rabbit urines following administration of sulphathiazole. In each case, crystals were isolated, purified and compared with an authentic sample of synthetic acetylsulphathiazole (first described by Fosbinder and Walter[5]). The crystals of both human and rabbit origin were identical in all respects with the synthetic acetylsulphathiazole. Sulphathiazole urines were centrifuged and the deposit allowed to stand with dilute hydrochloric acid. The deposit was then collected and extracted with a large volume of boiling ethyl alcohol, from which acetylsulphathiazole separated on cooling. It was purified by recrystallization from 80 per cent aqueous methyl alcohol. It formed rhombic prisms which were very sparingly soluble or insoluble in most solvents tried. The purified acetylsulphathiazole from human urine had m.p. 257° C. and from rabbit urine, 258°; neither depressed the melting point of synthetic acetylsulphathiazole, m.p. 257° (Fosbinder and Walter[5] give m.p. 256°–257°).

In addition to this acetyl derivative, rabbit urine following administration of sulphathiazole contains appreciable amounts of a conjugated glucuronide, presumably a derivative of a hydroxysulphathiazole. We have isolated this conjugated compound as a barium salt and a study of its structure is now in progress. This compound would appear to be analogous with the glucuronide of hydroxysulphapyridine isolated by Scudi[6] from dog urine after administration of *M.* and *B.* 693, and with the glucuronide of a hydroxysulphanilamide which we[7] have isolated from the urine of rabbits treated with sulphanilamide.

W. V. Thorpe.
R. Tecwyn Williams.

Physiology Department,
Medical School,
Hospitals Centre,
Birmingham, 15.
Oct. 17.

---

[1] Pepper and Horack, *Amer. J. Med. Sci.*, **199**, 674 (1940).

[2] Long, *J. Amer. Med. Assoc.*, **114**, 870 (1940).

[3] Reinhold, Flippin and Schwartz, *Amer. J. Med. Sci.*, **199**, 393 (1940).

[4] Carey, *J. Amer. Med. Assoc.*, **115**, 929 (1940).

[5] Fosbinder and Walter, *J. Amer. Chem. Soc.*, **61**, 2032 (1939).

[6] Scudi, *Science*, **91**, 486 (1940).

[7] Thorpe and Williams (to be published).

Cryolite Films on Glass Surfaces

Many years ago Mr. Dennis Taylor patented the tarnishing of optical surfaces for the purpose of increasing the amount of light transmitted. To-day, cryolite treatment of surfaces has become a routine operation. The common explanation of the phenomenon is that: (1) equal portions of light are reflected back from the outer and inner surfaces of the film; (2) the phases of these portions are such that they interfere with and neutralize one another so far as visual reflection is concerned; (3) the cryolite film must have a definite thickness.

Such a theory might explain the reduced reflection on the basis of interference. It does not explain the increased transmission, the factor of real importance. In practice, so far as transmission is concerned, precise control of the thickness is not necessary. It is determined only by mechanical considerations. Is there any need to seek for an explanation other than the orthodox and well-tried surface transmission phenomenon?

From Young's formula, $\frac{(N-1)^2}{(N+1)^2}$, the proportion of light transmitted through an air – glass surface, whether entrance or exit, may be determined. In the case of an interface, the more general formula, $\frac{(N_1-N_2)^2}{(N_1+N_2)^2}$, may be used.

If 100 units of light fall upon a flint lens having a refractive index of 1·65, 94 units pass through the entrance air – flint surface and 88·4 pass through the exit surface, the total loss being 11·6 units.

If cryolite films having a refractive index of, say, 1·35 are formed on the flint glass surfaces, then 97·8 units will pass through the air – cryolite entrance surface, 96·82 will pass through the cryolite – flint interface, 95·85 will pass through the flint – cryolite interface and 93·75 through the exit cryolite – air surface, the overall loss being 6·25 units instead of 11·64. These figures agree with practical experience.

If the refractive index of the film were reduced to 1·285, the overall loss would be reduced to the minimum of 6·05. Any further reduction of the refractive index of the film would lead to an increase of the loss. If the refractive index of the film were reduced to unity, or if it were increased to 1·65, corresponding with the flint lens, the conditions in both cases would be those of an unprotected flint lens. As the best value for the film is the square root of the refractive index of the glass medium, it is obvious that the best results are obtainable the higher the refractive index of the glass, for the reason that it is difficult to obtain practicable films of much lower refractive index than that of cryolite.

So far as reflection is concerned, although the thickness within fairly wide limits does not appear to affect transmission, there is an apparent effect upon back reflection, a portion of which is variable in intensity as the result of interference.

James Weir French.
(Chairman.)

Barr and Stroud, Ltd.,
Anniesland,
Glasgow, W.3.
Oct. 29.

Hyperfine Structure in the Arc Spectrum of Bromine

In a recent publication[1] we showed that the deviation from the interval rule in the 5*s* $^4P_{5/2}$ term of the BrI spectrum fits quite well the quadratic interaction formula

$$E = a_0 + \tfrac{1}{2}aC + bC(C + 1),$$

which arises when the nucleus has an electrical quadrupole moment. We have detected an arithmetical error in our calculations, and when the correction is made, the fit is even better than that previously reported. Thus the two *independent* check values for the constant *b* are now 0·175 and 0·170 (formerly 0·175 and 0·161), leading to two independent values for *a* which are 47·14 and 47·10 (units are cm.$^{-1}$ × 10^{-3}). The corrected interaction formula now becomes

$$E = 230{\cdot}1 + \tfrac{1}{2}\,47{\cdot}12C + 0{\cdot}172C(C + 1).$$

We wish to take this opportunity for correcting a few minor misprints in our published tables of structures (which contain some 200 components). These appeared only on printing and have no effect on the reported analysis. In λ 4513 read 180 for 150 ; in λ 4391 read $\widetilde{90}$ for $\widetilde{182}$; in λ 8334 (Fig. 3) read 163, 195 for 153, 185 (calc.), and 162, 195 for 152, 185 (obs.), in λ 4592 read $\widetilde{165}$ for $\widetilde{65}$.

S. Tolansky.
S. A. Trivedi.

Physics Department,
University,
Manchester.
Oct. 28.

---

[1] Tolansky, S., and Trivedi, S. A., *Proc. Roy. Soc.*, A, **175**, 366 (1940).

Ability of Respiratory-Stimulating Factors to Overcome Toxic Action of Germicides on Moulds

It is well known that germicides depress the respiration of both the micro-organisms and the tissues with which they come in contact. It has been shown that the depressant actions of a germicide on the respiration of the micro-organism and of the host tissue are directly correlated with the toxicities of the germicide for the organism and the host, and a comparison of these respiratory effects by manometric methods has been proposed for the evaluation of germicides[1].

In our laboratories it has been found[2] that the depressant action of germicides on the respiration of tissues can be overcome *in vitro* by the addition of various fractions from yeast which have been found previously to increase the respiration of yeast and tissues[3]. It has also been found that for certain of these fractions the ability to stimulate the respiration of yeast parallels the ability to stimulate yeast proliferation[4], although this is not always the case. In view of these two lines of work it became of interest to determine the effects of germicides and of certain of these respiratory-stimulating fractions (*RSF*) on the growth of moulds.

In typical experiments 28 Petri dishes were prepared containing Czapek's medium with different concentrations of germicide. These dishes were divided into four sets of seven each. The dilutions of germicide in each set were 1 : 1000, 1 : 10,000, 1 : 20,000, 1 : 50,000, 1 : 100,000 and no germicide, two sets containing phenyl mercuric nitrate[5] and two containing *n*-butyl-parahydroxybenzoate[6]. The medium in one set of each group contained one per cent of the *RSF*. Two sets were seeded with *Aspergillus niger* and two with *Penicillium glabrum* by placing one loopful of a sterile water suspension of the mould in the centre of the Petri dish. The fungi were grown at room temperature in the dark and were examined at intervals for a period of 14 days. Phenylmercuric nitrate alone was effective in inhibiting completely the growth of *A. niger* in a concentration of 1 : 100,000 and of *P. glabrum* at 1 : 20,000. Addition of one per cent of crude *RSF* (corresponding to Fraction *A*[3]) not only increased growth in the lower germicide concentrations where some growth took place normally, but caused growth equal to that of the control with the usually completely inhibitory germicide concentrations of 1 : 100,000 and 1 : 50,000 for *A. niger* and 1 : 20,000 for *P. glabrum*. Similar although quantitatively different results were obtained with Butaben. All experiments were repeated using Sabouraud's medium with similar results.

Experiments have further indicated that the crude yeast *RSF* also contains factors inhibitory to mould growth, that both the inhibitory and stimulatory factors are soluble in 85 per cent acetone, but that the inhibitory factor can apparently be removed by adsorption on charcoal. The acetone-soluble fraction is the most active of the fractions in increasing the respiration[3] and growth[4] of yeast and is inactive on the respiration of rat skin.[3] On the other hand, the acetone-insoluble fraction increases the respiration of skin but is not particularly active in stimulating growth and respiration of yeast or growth of moulds. It may thus be possible to use these active fractions in overcoming some of the toxic effects of germicides on the host without greatly impairing germicidal efficiency, and this possibility is being studied.

These facts are consistent with an interrelation between proliferation and respiration, although in many cases a more direct correlation has been found between glycolysis and growth[7]. This interrelationship is under investigation, as is the purification of the factors responsible for the observed effects.

Details of these experiments will be published later.

Elton S. Cook.
Cornelius W. Kreke.

Research Laboratories,
Institutum Divi Thomae,
Cincinnati, Ohio.
Oct. 2.

---

[1] Bronfenbrenner, J., Hershey, A. D., and Doubly, J., *J. Bact.*, **37**, 583 (1939) ; Ely, J. O., *ibid.*, **38**, 391 (1939) ; cf. also Miller, B. F., and Baker, Z., *Science*, **91**, 624 (1940).

[2] Cook, E. S., and Kreke, C. W., unpublished.

[3] Cook, E. S., Kreke, C. W., and Nutini, L. G., *Studies Inst. Divi Thomæ*, **2**, 23 (1938).

[4] Cook, E. S., Hart, M. J., and Stimson, M. M., in publication.

[5] Weed, L. A., and Ecker, E. E., *J. Infect. Dis.*, **49**, 440 (1931) ; **52**, 354 (1933).

[6] Butaben, Merck. We wish to thank Dr. R. T. Major of Merck and Co., Inc., for a gift of this material.

[7] Trowell, O. A., and Willmer, E. N., *J. Exptl. Biol.*, **16**, 60 (1939) ; Pomerat, C. M., and Willmer, E. N., ibid., **16**, 232 (1939).

Siegesbeckia orientalis in Britain

It is interesting to note that almost simultaneously with the publication of the note in Nature of October 12 of the twelve-year establishment of a colony of the alien composite *Siegesbeckia orientalis* at Freshfield Station, Lancashire (botanical vice-county 59), I have been able to add to my herbarium a specimen from a new station at Rufford, twelve miles inland westwards, and it is of further interest that some of the flower-heads have six bracts. It appears that the Rufford colony has been growing for some years in a sandy wild garden but was only recently identified in our work on the local flora for the Rufford Village Museum exhibit. It was locally believed that the plants might have been introduced with poultry food for they flourish abundantly and spread rapidly, especially after a bonfire. There is, nevertheless, the possibility of birds or hares transporting seeds adhering to sticky bracts from the Freshfield site.

Eric Hardy.

Merseyside Naturalists' Association,
Liverpool.
Oct. 19.

RESEARCH ITEMS

Iron Age Cypriot Jugs

Three jugs of Iron Age date from Cyprus have been figured and described by James A. Stewart (*Man*, October 1940). These jugs are now in the Biblical Museum, Melbourne. Their provenance is unknown; but it is believed that they are derived from one of the cemeteries between Avios Jakovos and Enkomi. The first has an ovoid body with ring base and strap handle, buff clay and surface slip painted in black with red filling, showing a bird flying to the right, with a lotus bud before it. Eyes consisting of concentric circles appear on either side of the spout. The second jug is of the same type with differences in size and form—yellowish-buff clay and surface slip painted wholly in black figuring a horned quadruped in profile to right, all four legs being hind legs with bird-like claws rather than hoofs. The head is fitted with concentric circles, the neck with basketry panels. The third jug is of similar type. The decoration on buff clay and slip is in black paint with red filling. On either side of a complex lotus design is a flying bird feeding from the lateral bloom. In the field above the bird's head is a swastika. The period is probably Cypro-Archaic I, eighth–seventh centuries B.C.

More Life-Histories of North American Birds

Arthur Cleveland Bent has added a thirteenth to the magnificent series of volumes describing the life-histories of North American birds, and in it he includes the parrots and parakeets, cuckoos, kingfishers, goatsuckers, swifts, and humming birds (*Bull. U.S. Nat. Mus.*, **176**, 506; 1940). The work is compiled with the usual thoroughness, as full a life-history as possible being given of the best-known subspecies of each species, with more restricted comments on any peculiarity shown by the remaining subspecies. Plumages are described in sufficient detail to enable the reader to trace the sequence of moults and plumages from hatching to maturity and to recognize the birds at any stage and at any season, and the range of each species and its forms is outlined. Many fine photographs of nests, nesting-sites, and young birds illustrate the monograph, which contains numerous statements of unusual interest. For example, in 1832 Wilson described the flocks of the Carolina parakeet, brilliant in its colourings of red, yellow, bright green, and soft blue, as being so large that "when they alighted on the ground, it appeared at a distance as if covered with a carpet of the richest green, orange and yellow", and the author traces the steps by which this, the only representative of the parrot family that bred within the United States, became exterminated by the direct intervention of man in the early years of the present century.

Mammals of Malaysia

The scientific workers of the Raffles Museum at Singapore have added enormously to the knowledge of the fauna of their province, and now the present director, F. N. Chasen, has brought together his own and other observations upon mammals in a "Handlist of Malaysian Mammals" (*Bull. Raffles Mus.*, No. 15. pp. xx+209; 1940). The area dealt with is bounded in a general way by the 100-fathom shelf, and includes besides the Malay Peninsula, Sumatra, Borneo and Java, and the adjacent small islands. As a whole the mammalian fauna is evenly distributed throughout the area, pointing to land connexions in times geologically not remote, but there are indications of affinities with different mainland faunas. A large constituent, of Indo-Malayan origin, is widespread over the whole region, although in many cases it is absent from Java. Northern influences from Indo-China are apparent in western and eastern drifts, and an eastern drift entered by way of Borneo where many species stopped, while others went on to Java. Finally there is an element now confined to the area, predominantly inhabiting the mountains at an altitude of more than 3,000 ft., and best represented in Borneo, which is most favourably constituted for the retention of old and the production of new animal forms. In Malaysia the mammals have been much more plastic than the birds, and in some cases the species are so split up that a list of the subspecies is little more than a list of the islands upon which the species is represented. Descriptions of thirty-nine new forms appear in the Handlist.

Development of Wings in Drosophila

Highly interesting facts are reported by C. H. Waddington (*J. Genetics*, **41**, 75–137; 1940) from his work on the genetic control of wing development in Drosophila. The place in development of the wing at which mutant genes first show their effect and in some cases the reasons for the appearance in the imago can be deciphered by studies in the ontogeny of the wing. Sixteen stages in the development of the wing are described in wild-type flies. The first observable effects of thirty-eight mutant genes are shown to influence the development at one or more of these stages.

Genetics of the Tails of Mice

Several genetic characters which affect the structure of the mouse's tail also affect other structures or processes of the body. One of these inherited characters, short tail—Danforth—is associated with spina bifida, suppression of kidneys and parts of the uro-genital system (L. C. Dunn, S. Gluechsohn-Schoenheimer and V. Bryson, *J. Hered.*, **31**, 343–348; 1940). The homozygotes *Sd Sd* die within twenty-four hours of birth, probably as a result of auto-intoxication through an aberrant urogenital system. On continual crossing of the heterozygotes with the inbred Bagg strain of mice through several generations, it was found that the tail became shorter. Another character, brachy short tail (*T*), when combined with the characters of the inbred strain, tends to increase of length. It is suggested that the difference is due to the different morphogenic channels of development on which *Sd* and *T* act. It is probable also that the viability of the heterozygous *Sd sd* form is decreased in association with the Bagg inbred strain. This has developed so far as to make *Sd* approach the state of a dominant lethal.

Biochemistry of Flower Pigments in Verbena

G. H. Beale, J. R. Price and R. Scott-Moncrieff (*J. Genetics*, 41, 65–74 ; 1940) show that the various pigments in the flower of Verbena are exceptional in their genetic behaviour. In Verbena, delphinidin derivatives may be either dominant or recessive to pelargonidin, while mixtures of derivatives of pelargonidin and delphinidin or of both with cyanidin are known. In addition, clear-cut segregation of different glycosidal types, of acylated and non-acylated anthocyanins and of qualitative differences in flavone occur in Verbena. These exceptional phenomena are considered to be the result of the interspecific origin of the garden Verbena.

A Lower Carboniferous Brachiopod

A DETAILED study of *Daviesiella llangollensis* (Davidson) and related forms, including morphology, biology and distribution, has been made by F. W. Cope (*J. Manchester Geol. Assoc.*, 199–231 ; 1940). It has been found that the extra pair of muscle impressions in the ventral valve of *D. llangollensis*, previously believed to be additional adductors, are in fact secondary divaricator impressions. In North Derbyshire *D. llangollensis* (s. lato) is present in beds of S_2 and basal D_1 age ; and specimens from these beds are divisible into two related groups : a lower one, confined to S_2, containing specimens differing from the lectotype in the condition of the secondary divaricator impressions (*D. derbiensis* sp. nov.) ; and a higher one, from the S_2–D_1 beds, in which the specimens are identical in every respect with the lectotype of *D. llangollensis* (s. str.). In North Wales, including Anglesey, and Westmorland the stratigraphical position of each species is the same as in North Derbyshire. It is concluded that the members of the *llangollensis*-gens are very shallow-water forms. The distribution of *D. llangollensis* is indicated on a sketch map which shows that the brachiopod appears to be present only to the north of the old Carboniferous St. George's Land. There is so far no evidence that the brachiopod exists in the South-Western Province of the Avonian.

Inactivation of an Enzyme

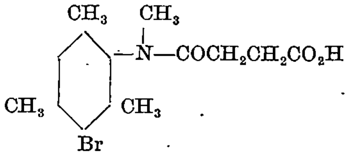
INFORMATION about the action of an enzyme might be obtained from the quantum yield on deactivation by light. If the specific activity is located in a definite part of the molecule a low quantum yield would be expected, whilst if the quantum yield is unity, inactivation may result from an alteration of almost any part of the large molecule. Urease has a high molecular weight of 483,000 and its light absorption must be distributed among several absorbing centres. E. W. Landen (*J. Amer. Chem. Soc.*, 62, 2465 ; 1940) has measured the absorption spectrum of urease in a pyrophosphate buffer solution at $pH = 5{\cdot}6$. A maximum molecular extinction coefficient occurs at about 2700 A. and a minimum about 2480 A. The quantum yield for inactivation is fairly constant over the region of wave-lengths 3103 A.–2537 A. and has the value 0·0008 molecule per quantum. It increases at shorter wave-lengths and reaches the value 0·00938 at 1860 A. The direct radiation from a low-pressure mercury discharge tube was more efficient in deactivating urease than monochromatic radiation of 2537 A., and this was shown to be due to radiation of wave-length shorter than 2350 A., probably the mercury line at 1849 A. The small quantum yield indicates that the enzyme activity resides in a unique region of the molecule. The divergence of the results from those of Kubowitz and Haas made in 1933, before the molecular weight of urease was known, are discussed and it is considered that the different experimental conditions are partly responsible.

Methylboric Acid

ALTHOUGH numerous monoaryl and alkyl boric acids have been prepared, the simplest compound of this class, methylboric acid $CH_3B(OH)_2$, has been missing. A. B. Burg (*J. Amer. Chem. Soc.*, 62, 2228 ; 1940) has now prepared this acid and its anhydride, which is trimeric $(CH_3BO)_3$, by an improvement of a method tried by Khotinsky and Melamed in 1909, namely, the action of methyl magnesium iodide on methyl borate. The crude product was dehydrated to methylboric anhydride by means of anhydrous calcium sulphate in a special apparatus. By treating the anhydride (m.pt. −38°, b.pt. 79°) with a deficiency of water and removing the excess of anhydride by distillation, methyl boric acid was obtained. This is volatile, but the vapour is extensively dissociated into anhydride and water, and its melting point is 95°–100° with decomposition. In contrast to the hydrolytic action of water, ammonia and trimethylamine form addition compounds with $(CH_3BO)_3$. By the action of boron fluoride a new compound, methylborondifluoride, is formed: $(CH_3BO)_3 + 2BF_3 = 3CH_3BF_2 + B_2O_3$. The compound $(CH_3)_2BF$, which was also not previously known, was prepared from dimethylboric anhydride (from phosphorus pentoxide and dimethylboric acid) by the reaction: $3(CH_3)_2BOB(CH_3)_2 + 2BF_3 = 6(CH_3)_2BF + B_2O_3$. Methylboric anhydride probably has a hexatomic ring structure with alternate boron and oxygen atoms in the ring, as is indicated by electron diffraction measurements.

Restricted Rotation in Arylamines

OPTICAL activity due to restricted rotation between a carbon of the ring and the nitrogen atom attached to it has been reported by Mills in the case of certain arylamines. R. Adams and L. J. Dankert (*J. Amer. Chem. Soc.*, 62, 2191 ; 1940) now report the resolution through its brucine salt of N-succinyl-N-methylbromomesidine, the formula of which shows that the molecule should exhibit a restricted rotation. The compound was synthesized from mesitylene by way of nitromesitylene, mesidine, bromomesidine and N-methylbromomesidine, which was purified through the nitroso compound. The optically active forms were stable in boiling ethanol or aqueous sodium hydroxide, but gradually racemized in boiling *n*-butanol. The optical activity was shown to be due to restricted rotation between the carbon of the ring and the nitrogen atom and not to an asymmetric nitrogen atom, since the active forms were brominated to the inactive N-succinyl-N-methyldibromomesidine and were nitrated to the active N-succinyl-N-methylnitrobromomesidines.



AUTOMOBILE RESEARCH

ON the invitation of the Institution of Automobile Engineers, a representative of NATURE was privileged to inspect its new Research Laboratory at Brentford and to see a cross-section of the important work which is being done there under the superintendence of the director, Dr. E. Giffen, for the benefit of the automobile industry. The chairman of the Research Committee, Mr. W. A. Tookey, explained how its scope has been developed during the ten years since this co-operative work was taken over by the Institution and organized on a wide basis whereby it consists of representatives from the Institution, from affiliated members and from Government departments.

The work of the Committee is financed by grants from the Department of Scientific and Industrial Research and by contributions from the Society of Motor Manufacturers and Traders and from the affiliated members, who now number more than three hundred firms—including many who have their own research departments but at the same time find it an advantage to work in close co-operation with the Research Committee.

The new laboratory has been designed and built specially for the work being carried on there and provides excellent facilities for the many classes of investigations which arise in connexion with the engine, the transmission, the chassis and the operation of automobiles. Some of these give rise to questions of fundamental and general importance which at the same time involve problems of design and operation. A series of investigations illustrative of this range of interest is being developed at the present time which relate to the frothing or aeration of oil and to its harmful effects in service. In the chemical laboratory the fundamental causes which give rise to aeration of the lubricant are being investigated, and it may be anticipated that the results will yield information of wide application wherever frothing occurs either as an advantage or as a disadvantage in industry. Parallel investigations are being carried out in the chassis laboratory and in the engine laboratory to determine the effectiveness of de-aerating devices and to ascertain the influence of aerated oil on the behaviour and loading capacity of engine and other bearings.

Another investigation of a fundamental nature which is in course of development is intended to study systematically the factors which control the scuffing of piston rings, a phenomenon which can occur both under idling conditions and at high loads and temperatures. The work is being carried out on a single-cylinder, liquid-cooled unit coupled to a hydraulic dynamometer. The temperature of the jackets is closely controlled by the use of ethylene glycol in conjunction with a cooler, and the supply of lubricant to the cylinder walls is also under regulation. At the moment, the experimental work is directed towards the establishment of a satisfactory testing technique, and when this has been done it is proposed to examine the relative merits of various surface finishes and treatments for piston rings, and of different designs of rings.

The equipment of the cold room which forms a notable feature of the general laboratory has been designed to enable a detailed study to be made of the starting performance of engines at low temperatures. It can be operated at thermostatically controlled temperatures down to −25° C. and is large enough to accommodate two full-size engines, mounted on test-beds run into the cold room on a movable ramp. A large capacity tank containing a low freezing point coolant is placed above the engines and by means of an electrically driven impeller and a system of three-way cocks the coolant can be circulated through either engine. The advantage of this arrangement is that it allows prolonged motoring test runs to be made without excessive temperature rise due to engine friction. The engines can also be driven through a swinging field dynamometer and a 10 : 1 reduction gear outside the cold room which enables a range of speed from 10 to 200 r.p.m. to be employed, while the incorporation of a free wheel in this gear permits the engine to accelerate when starting.

A line of research of very timely importance is one which is being arranged in order to study systematically the power loss resulting from the use of producer gas in a converted petrol engine. The gas used is produced from anthracite in an "Emergency" dry type producer which, in order to simulate road conditions, is mounted on a bumping rig and is subjected to a cooling air blast, in addition to the circulation of water through the jacket. The engine is a six-cylinder, side valve unit of 3·5 litres of a type commonly used in trucks up to three tons capacity. Immediately beyond the throttles, the gas and air are fed into a common pipe which acts as a mixing chamber. This pipe is connected to one branch of a tee-piece mounted on the engine intake manifold, the other branch being arranged to carry the normal petrol carburettor, which is enclosed in an airtight box. The arrangement of the controls in conjunction with this system of connexions permits the engine to be run either exclusively on producer gas or on producer gas combined with varying degrees of petrol enrichment. Provision has been made for manual adjustment of ignition timing, and in addition to studying the performance of the standard engine on producer gas, possible means of making good the power loss by raising the compression ratio, by increasing the calorific value of the fuel and by the injection of steam in the producer have been under investigation.

These by no means exhaust the tale of the activities of the station for many investigations of a routine nature are being pursued, such as gear testing, crankshaft fatigue testing, and measurements of the durability of bearings and bearing materials under different conditions. These are all yielding information of the utmost value to the industry and providing an accumulated fund of knowledge which will lead to improvements in design and higher efficiency in operation. This is well illustrated by a test which was seen in operation in the general laboratory and which had been arranged to obtain data as to the transmission of heat from a brake drum to a wheel rim and tyre. On buses operated under severe city service conditions, particularly in hilly districts, trouble arises in consequence of the excessive temperatures which reach the tyres and inner tubes, by transmission of heat from the brake drums. At one end of the axle in the apparatus used for the test the wheels rotate against a continuous braking force applied through the normal brake rods, the braking load being shown on a spring balance. The wheels at the other end are prevented from rotating by a torque arm and a spring balance indicates the brake torque applied to them and transmitted through the differential. Temperatures are measured at various parts of the apparatus by means of copper-constantan thermocouples. For parts which are rotating, the leads are soldered to pairs of copper and constantan slip-rings. In this way frequent temperature measurements can be made at selected points in the wheel rim, the brake drum, and the brake lining.

It has been possible to indicate in this survey only the more outstanding of the tests in progress, but the full extent of the research work which has been completed can best be seen in the list of reports which have been prepared by the Laboratory. Among the latest of these are papers dealing with fuel economy and with the distressing phenomenon of brake squeak. In addition the research department abstracts and classifies technical information from English and foreign papers, and these abstracts and the full resources of the library are available to assist members in any technical problem or inquiry which may arise. In these ways the Laboratory is playing a most important part, and its new premises and equipment, used with the vigour that is apparent in its direction, give the assurance of even greater usefulness in the future.

PLANNING THE POST-WAR WORLD

In his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. R. Beard reminded his audience that exactly twenty years ago, when chairman of the North-Eastern Centre of the Institution, he read a paper on "Post-war Conditions and Developments, with particular reference to the Electric Supply Industry". On re-reading it to-day, he found that purely technical achievement has fulfilled, and in many cases exceeded, the expectations then expressed. Where we have largely failed is in having no clear idea of the purpose for which these technical achievements should be used, and also in lacking ability to arrange that co-operation with non-technical people and interests which is necessary if the engineer is to produce the structure that he knows to be most efficient and useful to the community.

As a starting point, it is assumed that we all recognize that the War has brought about, and is bringing about, tremendous changes not only in our environment but also in our whole outlook on life, and that we are all prepared to agree with *The Times* that "To liberate Europe from Hitler does not mean to reverse the whole process of economic integration which has been set in motion. . . . Much harm may be done to our cause, both in Europe and oversea, by the insinuation that we stand for the old order and that our only aim is to restore the *status quo* in Europe and to maintain it at home. This charge should be emphatically and authoritatively refuted".

There is herein implied some, possibly belated, recognition that the old order is no longer producing a healthy and happy community and that, for one reason or another, apathy, selfishness and discontent, too much freedom in some directions and too little in others, were gradually undermining the character and vigour of the democratic nations. The malaise from which the democratic nations have been suffering is aptly summed up by the eminent American writer, Walter L. Lippman: "The muddle of the democracies comes from something deeper than their form of Government; it comes from the gradually accelerated destruction of all convictions about the nature of man and his destiny. . . . For how can this planet be governed by people who have ceased to believe that there is good and that there is evil?"

Dorothy Thompson, another American writer, suggests that the primary origin of the War was the secession of Germany from Western civilization and that we are fighting a great civil war to force Germany back into it. She defines Western civilization as follows:

"It is not democracy, not parliamentary government and certainly not capitalism. All of these are merely manifestations of something else—temporary forms to express a more permanent content. Nevertheless, Western civilization is definable. It is the synthesis of three things: the Christian ethic; the scientific spirit; and the rule of law. The essence of the Christian ethic is that the weak have rights as well as the strong, and that the strong must set limitations on their own power. The essence of the scientific spirit is that the search for truth transcends the State and may not be limited or suppressed by the State. It presumes the separation of State and culture, that is, the separation of culture from force. The essence of the rule of law is that contract is superior to arbitrary force, it presupposes a continuity of relationships . . . from whose sovereignty no one is exempt, not the King, not the President, not the powerful, not the weak".

Mr. Beard concluded by considering electrical planning in the Empire. Where central or national generating authorities have been set up, the functions of supervision have usually been carried out by them—as in Eire, Victoria and most of the Canadian provinces. South Africa, Quebec and Southern Rhodesia have followed more closely the example of Britain in establishing a separate supervising authority, but on a narrower basis and with little control of municipalities. Similar bodies, with varying powers and functions, also exist in British India, New South Wales, Queensland and Kenya, but elsewhere in the Empire supervision is usually exercised directly through Government departments, which are in many cases primarily devoted to some allied activity such as local government or public works.

The variety of conditions under which electricity is generated is so great as almost to defy classification, but there has been a strong trend, particularly in the Dominions, towards some form of monopoly. For the most part this has resulted from the establishment of independent Government commissions, of which Victoria, Ontario, Eire and South Africa are the best known examples, though there are smaller organizations such as the one in Trinidad.

Frequently a Government department has built and operated generating stations, gradually becoming a monopolist in the field of generation and bulk transmission. This has happened in such varied places as New Zealand, Western Australia, some Indian States, Malta and the Gold Coast. Over the rest of the Empire private and municipal enterprise dominate the field, though the trend towards monopoly is still clear.

In failure to take account of the difficult problems ahead lies our greatest danger. It is a danger specially to be guarded against by the younger electrical engineers, who must as years go on carry more and more of the responsibilities of the profession and whose lives will, to a great extent, coincide with the years of opportunity for the reconstruction of society and the building of a better world than they have inherited. These words of Sir Philip Sidney should be their inspiration : "It is the temper of the highest hearts to strive most upwards when they are most burdened".

ELECTRICAL AND MECHANICAL TRANSMISSION OF ENERGY

THE Andrew Laing Lecture to the North-East Coast Institution of Engineers was given on November 1 at Newcastle-on-Tyne by Prof. W. M. Thornton. He chose as his subject the foundations of the electrical and mechanical transmission of energy. From the earliest times men have sought to find the 'nature of things', and of the great branches of science into which their investigations have been gathered that of physics is both the most general and the most profound. It is essentially an experimental science ; but its greatest advances have been made by the use of mathematics. The applications of physics that form the scientific part of engineering have been the most effective when experiment and theory have moved together in rapid interchange, and in no part of the subject has this been more marked than in that which deals with the transformations of energy. It is only within this century that the identity of energy, for so long a subject of debate amongst scientific workers, has been firmly established. It is as real as matter itself.

The ten years between the discovery of X-rays by Röntgen in 1895 and Rutherford's establishment of the electrical constitution of matter have been described as the most fruitful in the history of science. To this amazing period we owe X-rays, the discovery of the electron, radioactivity, radium itself, relativity, the quantum theory of radiation, the development of radio-communication and the discovery that atoms are hollow planetary systems of elemental charges of positive and negative electricity, the proton and the electron. This last, together with the relation that is a consequence of the theory of relativity, namely, that matter is a form of energy, and hence mass, electricity and energy are convertible terms, places the doctrine of the identity of energy on a firm basis of reality.

In order to possess energy, the body or system of bodies in which energy is for the time located must either be in motion, in which case the energy that it has by virtue of its motion is called kinetic, or be part of a state of elastic strain, when it is termed potential energy or energy of position. A weight when raised acquires potential energy from the added electric strain of the ether of space that carries gravitational forces. In order that energy should be transmitted from one place to another it must be transformed from one of these states to the other, and the means by which this is in general done is the problem to which Prof. Thornton directed special attention. It is a problem of great theoretical and some practical interest. It is known that there is one law governing the whole range of the transmission of energy, whether in electric or mechanical engineering. This law is little known and is rarely referred to. Though occasionally used in the solution of electrical problems, it has never hitherto been applied to the consideration of those which deal with the transfer of energy by mechanical means.

There are problems of the transfer of energy which are met daily to which as yet there is no complete answer. How, for example, does a pendulum work ? At the end of its swing the energy is all potential, in the middle it is all kinetic. There is an almost perfect conservation of energy, but no one knows how the transformation takes place from the one form to the other. Its complete solution would require an understanding of the physical nature of gravitation and of the ether that has evaded scientific research from the time of Newton onwards.

One property of gravitational force that engineers may accept without question, though there are mathematical devices to evade it, is that to hold the planets in their orbits, it must be able to support great tensile forces. How these forces are derived physically from the matter of the sun and the earth is as yet unknown, though since matter is electrical in its constitution a gravitational field must have an electrical component in order to take hold of it. For many purposes the conception and use of this component is sufficient to illustrate the universal law which has been referred to, and on the assumption that all mechanical forces are electrical in their origin it may even be used to explain the working of a pendulum.

An equally familiar property of space is that it transmits radiation, from the extremely short and rapidly oscillating X-rays, through the regions of light and heat to the relatively long and slow waves of radio. These waves are in every case electromagnetic ; they all travel at the same speed through space, which we know to be the most perfect non-conductor of electricity, and in the case of radiation from the sun they carry the immense thermal energy by virtue of which life on this earth is possible. How this transmission of energy can take place through an insulating medium was shown some seventy years ago by James Clerk Maxwell, who based his electric theory of light on Faraday's discovery of magneto-electric induction and the polarization or strain of insulating materials of dielectrics in an electric field of force. Maxwell's theory led in the end to the invention of radio, and brought the antipodes within reach of a telephone call. But even Maxwell, though he had found by mathematical analysis the velocity with which electromagnetic waves travel in space, that is, the velocity of light, and knew that both the electric and magnetic fields in these waves were transverse oscillations of the ether at right angles to one another, did not find or state the law connecting them and the mode of transmission of their energy. This was done some twenty years later by Prof. J. H. Poynting who, in extending Maxwell's theory, derived the simple and powerful relation known as Poynting's theorem or law. It is that everywhere in Nature, energy flows by the mutual reaction of electric and magnetic fields, that it is delivered in a direction at right angles to the plane containing both of them, and that the power is simply proportional to the product of the fields. The passage of every form of electrical or mechanical energy obeys this law, and now that we know that there is nothing in the material universe but electricity, it may even be regarded as one of the most illuminating physical relations in Nature, since electricity or electrification moves everywhere according to this rule.

A field of force in physics is defined as a state of stress that is in its origin electric or magnetic. It produces attraction between unlike charges or poles and repulsion between those of the same signs. A short account was given of Rutherford's electrical theory of the constitution of matter, pointing out that in the metal of a 2,000-ton ship there are a little more than a ton of electrons. For energy to travel there must be in every case, electrical or mechanical, an electric field and a magnetic field at right angles to it. Around and in an electric wire carrying a current there are two electric fields, one outwards or inwards at right angles to its surface through the insulation around the wire, and the other along the conductor commonly called the ohmic drop.

Modern high-tension cables have a cylindrical sheath of solid insulation of very high quality round the conductors which can easily carry an electric field of 10,000 volts per cm. This intense concentration of power is not in the wire but in the paper or rubber insulation surrounding it. Any electromagnetic energy that enters a metal never comes out of it except as heat, or in the case of machines, as mechanical stress.

At the end of a line where power is utilized there must be a relaxation of the electric field in order that energy may be transferred. There is no difference in principle between direct and alternating current transmission, for in the latter case both the electric and magnetic fields reverse together and the direction of the energy path does not change with that of the current. But if there is a difference in phase between the current and the voltage we have to multiply their product by the cosine of the phase angle to get the true power. Radio-transmission plays a large part in modern life and though the means by which it is done are highly technical and complicated, the movement of energy in free space once it has left the transmitter is relatively simple. The great masts and aerials that we see are in effect condensers to which very rapidly alternating voltage is applied. While a vertical antenna is being charged, in the millionth of a second, the current is moving upwards against the electric field that is piling up at the top, the direction of which is downwards.

When we come to consider the movement of energy in mechanical systems of transmission, we encounter the release of energy known as combustion. Sir William Ramsay was one of the first of chemists to realize the electrical nature of atomic forces.

Prof. Thornton concluded by carrying the general argument to its logical end. Before the coming of the electrical theory of matter, the highest flight of scientific imagination was to conceive a dead universe of cold worlds; but now we know that all that is necessary to bring it to an end, to uncreate it, is that the equal number of positive and negative charges that make up its atoms must be made to cancel one another out and 'leave not a rack behind'. But the energy that formed the universe will still remain, eternal and unchanged.

VISIBILITY AND ROAD ACCIDENTS

MOST research work on road accidents has been concerned with the physical or mental state of the driver of the car, but H. H. Ferguson and W. R. Geddes, in *Occupational Psychology* (14, No. 4), describe some recent work done in New Zealand on road accidents from a very unusual point of view. These writers investigated the beliefs of pedestrians regarding their own visibility, to see how far these beliefs compared with their actual visibility.

The method in outline was to get the subjects to walk along a straight, level, unlighted, open-country, dustless road, away from, or towards, the headlights of a stationary car. They had to indicate by pegs those points along the road at which they believed: (*a*) that it was just possible, but not likely, that they were out of the range of the visibility for the driver; (*b*) that they had a normal degree of certainty that they were just beyond the range of visibility for the driver; (*c*) that they were certain of being just outside the range of visibility for the driver.

It had been discovered that the greatest distance at which a typically attired moving pedestrian could be distinguished as a pedestrian with reasonable certainty was approximately 320 ft., while beyond 463 ft. nothing could be seen of the pedestrian.

When the results were analysed a wide range of distribution of distances was revealed. A considerable number of the subjects considered themselves to be visible when actually well beyond the range of visibility; one subject thought he was visible at 814 ft.

The authors hold that, if these findings were to be substantiated by further research, publicity should be given to this possibility of error, for the belief that one is visible when one is actually invisible is a dangerous belief. This is an interesting contribution to the complex problem of road accidents. If this possibility of error is important in New Zealand it is still more important in Great Britain, and particularly in black-out conditions.

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 30, 1940 No. 3703

EDUCATION FOR THE FUTURE

IN his chapter on "Science and Free Culture" in his recent volume "Freedom and Culture", Dr. Dewey emphasizes the importance of developing the scientific outlook throughout a democracy, and not merely concerning ourselves in the general teaching of science with the dissemination of facts in particular branches of science. This attitude is a vital safeguard against wholesale misleading by propaganda, and is essential if science is to exert its real cultural effect.

The importance of this in education is very far from being realized, but Dr. Dewey is undoubtedly right in his firm warning about the dangers of any educational system in a democracy in which what is taught and how it is taught is not determined upon the basis of the formation of the scientific attitude. Unfortunately, there is little evidence that its significance has been realized in the various renewed attempts to deal with war-time problems of education which have recently been made. The Haining Committee appointed early this year to recommend how education could play its part in the welfare arrangements required during the coming winter does not appear to have paid any particular attention to science despite its importance in war itself.

Neglect of this factor is disturbing. It profoundly affects the mental alertness which is no less important to military efficiency than in civilian life. In fact, the two are so closely interlocked that the question of army education is one that may make a most important contribution to reconstruction after the War, particularly where rehabilitation and readaptation are concerned. Mr. Anthony Eden has emphasized the importance of education and welfare as a factor in keeping the Forces 'fighting fit'. The only real fitness is fitness of the whole man. A civilized nation in arms is a nation which continues to cultivate all its capacities of heart and mind, body and soul.

We may well regret that the Government was so long in making its decisions and that greater advantage was not taken of the months when relatively little actual lecturing and teaching could be done to develop the organization of the educational staff within the Forces themselves. There is still time to prevent the waste of another winter now the civilian bodies are thoroughly organized through the regional committees to meet whatever demand the Forces may make, and it is to be hoped that scientific workers themselves will not neglect whatever opportunities may be theirs in this way of spreading the scientific outlook and approach to problems of modern life.

It is equally to be regretted that in the fresh plans being formulated for the training of youth, there has been undue delay, and also there is no sign that the important safeguard which science can offer in this way against some of the most insidious dangers to democracy is yet realized. Mr. Ramsbotham's speech on October 16 went far to reassure the misgivings which had been engendered in some quarters by the proposals for the physical training of youth. There is no reason to fear that such training will be given an ex-military bias or emphasized at the expense of other sides of education, or that the day continuation scheme may be substituted for the raising of the school age. Mr. Chuter Ede, the Parliamentary Secretary to the Board of Education, explicitly declared that the suspended 1936 Act still represents the Government's policy.

There is no reason, therefore, to doubt that the Government's view of education is broad and essentially sound. Mr. Bevin's vigorous and welcome language about educational reform indicates that there, at least, some of its members hold much more progressive views than some members of the House of Commons. We cannot, however, expect the commensurate Government action unless the House of Commons and public opinion behind it are really alive to the issues involved, and the onus for seeking to stimulate pressure for a more generous policy at the end of the War remains on those who are aware of its importance to the nation.

The raising of the school-leaving age to sixteen with satisfactory provision for continuation schools afterwards are only means to an end. They might prove as sterile as the youth movements of Germany and Italy, which are rightly shunned in Great Britain, if they do not receive the right educational content, wise use and inspiring leadership. The training of youth has to be approached in relation to the needs of youth, whether physical or recreational, as well as in relation to the needs of the community in which youth has to take its place. Peace-time industry no less than the needs of a nation in arms may make demands on the health of the adolescent inconsistent with juvenile welfare, and the consequent adjustments can only be made satisfactorily in the light of a real and far-sighted policy which is not obsessed with the immediate reactions or requirements.

Fundamentally, the training of youth to be successful must meet these requirements : it must produce leaders ; it must provide means by which youth can play its part in the national effort now ; and it must fit youth to take an adequate part not merely in a nation at war but also in the new world order to be established and in the building of that order. Those requirements can only be satisfied by a really long-range policy, broadly conceived, and embracing all the activities in welfare work and recreation, in industry and in military or naval life, which are shaping the youth of to-day and the leaders of to-morrow. Consideration of the content as well as of the manner of education is imperative and it essentially implies the introduction of a long-term national policy of scientific education.

Prof. J. H. Newton's recently published distinguished study of education for democracy* is of special interest in this respect because he goes far beyond the American conditions which are his immediate concern and lays bare the fundamental principles in the light of which particular conditions both in America and in Great Britain must be studied. From the outset he emphasizes two points : first, the relation of education to the society in which it occurs and the importance of education as an instrument for social control ; and second, the significance of the scientific method as an invaluable and indispensable method for the study of social and educational problems.

In regard to the first point, Prof. Newton refers to the constant pressure to which schools and teachers are now subjected by individuals and groups who seek to control education and direct it to the ends which they approve. The Tennessee statute forbidding the teaching of evolution is only one example of this tendency, but sufficient to show that freedom of teaching is in real danger even in a democratic State. Even the use of the schools for propaganda of the rational type, for social and moral reforms, is open to criticism and objection in view of the dangers attending it and the precedent it may afford for propaganda of a biased or anti-social type.

To object to such methods is not to assert that education has no concern for the shape of the society of the future or is without guidance as to the nature of the changes that must be effected. Education should prepare men to cope intelligently and effectively with the problems of their time. It is aimless and purposeless unless concerned both with the process of effecting changes and with the purposes to be achieved. The future citizen must learn not only how to think for himself but also how to act for himself, and teaching in which a teacher discusses practical problems without in the end indicating ways of approach is ineffective and incomplete.

All this, however, does not involve the teaching of a detailed blue-print for the new social order. Education is a social process that has social consequences, and it must at least aim at the building of minds sensitive to the social realities of the world in which they live, that are free, that have acquired the capacity of thinking for themselves, because they have had opportunity to think for themselves. This, however, in Prof. Newton's view, is insufficient. Education is also experience. It cannot be indifferent to the conditions in the social order that threaten freedom of thought, of speech and of Press and other democratic values.

---

* Education for Democracy in Our Time. By Prof. Jesse H. Newton. (McGraw-Hill Series in Education.) Pp. xv+242. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 16s. 6d.

Education must be deliberately planned for the achievement of purposes deemed desirable. In a democracy it must at least seek to foster loyalty to the ideals of freedom of inquiry, of thought, of speech, and of publication.

Prof. Newton points out that the process of education is not merely one of acquiring knowledge in the traditional sense. Knowledge is of fundamental importance, but the way in which knowledge is acquired and the aptitudes built up in the process are also vitally important. Youth must gain some understanding of the reliance of democracy on the methods of intelligence, on the most exact methods of assembling and verifying data for utilization in the formulation of policy, and practice in the application of these methods and techniques to critical social problems of concern to them. Effective understanding by youth of the intellectual bases of democracy and of the crisis in thought arising from the conflict between the two great systems of values in the contemporary world is essential if education is to serve democracy.

It is at this point that the scientific method and the outlook involved therein fulfil a further function. Besides promoting the understanding of the great social trends and problems of our time, they afford the only adequate safeguard against the dangers of propaganda. Some knowledge of the scientific method, the ability to assemble pertinent data, to scrutinize it carefully, to make the inferences and only the inferences that the data warrant, the ability to see relations, to look beneath the surface of things are imperative assets if individuals are to resist propaganda. Revolution in the content and methods of education might well be justified if it did no more than make youth aware of the propaganda beating upon it and gave youth the ability to detect it.

The handling of the whole range of problems associated with the training and welfare of youth on such lines and in this spirit would make a vital contribution at least to the building of the peace if not also to the winning of the War. On youth itself must fall a large share of the responsibility for bringing back to sanity and balance the youth of Germany, whose education for a decade has been distorted and perverted to barbarism. Only a youth whose feet have been guided to this point can be expected to throw up and loyally follow leaders of the wide vision and moral courage required to repair not merely the ravages of war, but also to reinvigorate our democratic system, give new inspiration and meaning to its ideals and work out more effective means of serving humanity.

Prof. Newton has given us a timely book though he barely touches on one live issue to-day raised in Mr. T. C. Worsley's somewhat uneven study of the public schools and implicit in Mr. Bevin's recent remarks regarding the admission of boys of the secondary schools to the diplomatic service. The undoubted value of the public school system in providing leaders should not blind us to the basic fact that the best ability for the service of the country, whether in diplomacy or in any other field, can only be secured by recruiting it from the widest possible area of selection. A system which divides the rising generation into two sections in accordance with the incomes of their parents is not only inimical to such selection but, no less important, creates a grave obstacle to effective co-operation in adult life between those who have been systematically segregated in youth.

Prof. Newton's chapter on equality of opportunity does indeed bear on this point, although he is considering the problem as it is presented in the United States. The social waste, however, to which he refers is to be found wherever lack of resources limits the educational opportunity. It is also a function of the economic and cultural level of the country in which the children live, and the reminder that schools controlled by a particular group in society, whether political or religious, or by a social class, will be bent to the purposes of that group or class is as pertinent to conditions in Great Britain as in America. The integration of the public schools into the educational system so as to eliminate the segregating influence of financial resources, whether by pursuing the idea of the Junior Local University propounded by Mr. Worsley, or in accordance with Dr. Middleton Murry's suggestions, is one of the most important contributions which could be made to the planning of education and the rebuilding of the social order. In education the broad view and the long-range purpose are all-important. It is indeed to be hoped that the attention now being concentrated on the training and welfare of youth may not be dissipated in mere palliatives or patchwork schemes designed to meet passing needs or difficulties, but rather issue in some comprehensive policy, boldly conceived and resolutely pursued, which shall bring new strength and vigour to our democratic institutions and win acceptance and respect for those ideals in the lands where the light of liberty is for the moment extinguished.

CONTACTS AND CULTURES

THE proposal to found in London a mosque and Islamic cultural centre (see p. 712) will be a cause of gratification not only to those whose more immediate needs will be served by such an institution, but also to all who will welcome the enlarged opportunities it will afford of contacts between East and West, and of the fuller understanding which, if it does not remove, will at least lower the barriers between peoples of different cultures, beliefs, and traditional outlook. The project has taken form largely owing to the personal interest and effort of His Excellency Hassan Nashaat Pasha, the Egyptian Ambassador in London, and from the beginning it has received the patronage of King Farouk. The extent of the support it will receive in the Moslem world may be gauged from the composition of the influential committee preparing the scheme. It includes representatives of the Moslems of Arabia, of Iraq and of India in addition to those of Egypt.

The good will towards the Moslem community displayed by the British Government in its response to the appeal carries on the tradition of tolerance amid a diversity of creeds and cultural traditions, which for long has been among the more notable characteristics of British imperial rule, and now has been passed on to the British Commonwealth of Nations. It comes at an appropriate moment. The minds of men, even amid the intense pre-occupations of a bitter struggle for existence, are already casting about for solutions of the grave problems of a post-War world. Then, if all goes well, the "New Order" of democracy (to adopt Mr. Roosevelt's phrase) will be confronted with the task of recasting the conditions of life of the whole world. Not again, if we are to profit from past mistakes, will the determination of racial, or national boundaries completely fill the foreground and middle distance of the picture. It is permissible to predict that where they appear, if appear they must, it will be in the true perspective of their subordination to the general interests of the whole and not solely of the component parts. World order will, in fact, have to be adapted to conditions, some of which will have suffered a profound change, while others will have to be remoulded drastically and to a new purpose to avoid the pitfalls of the past.

Already the President of the United States invites the Americas to a co-operation based upon a spiritual unity. In Africa, General Smuts foreshadows a Union of African States. Such a union should afford an ever-increasing opportunity for those ameliorations of the conditions of human life and progress on that continent on a scale, not indeed undreamed of, but hitherto beyond the resources of individual administrative units. In Europe the agreement between Poland and Czechoslovakia opens the way to a post-War nucleus of stability in Central Europe, such as might have been formed in Western Europe had not the proposed co-operation between France and Great Britain proved abortive. Even more suggestive, because of the implications of close personal and cultural contacts, are Mr. Bevin's plans for the forging of a new industrial link between East and West by bringing some hundreds of men from the workshops of India to receive a training in the workshops of Great Britain. Thenceforward not only will India be in a position to make great strides towards fuller development of her potentialities in contribution to the world's output, at the same time raising her own standard of life, but also closer contact between individuals of both peoples will have brought fuller understanding of the problems of each.

Except in so far as such proposals can be given immediate practical effect, it is too early to attempt to evaluate them. They will have to stand the test of discussion and experience ; but if the past history of the British Empire affords any criterion, their prospect of securing stability and co-operation will depend upon the degree to which they are framed to allow free play to individual cultural and traditional differences. Just as the proposed mosque in London, with all the intellectual and cultural activities of Islamic tradition associated with it, will take its place in contributing to the life and functions of the capital city of the British Commonwealth, so racial and national traditions will not, or should not, vanish in post-War adjustment, but should be preserved, so that each may make its appropriate contribution in the advancement of the general good of mankind—a general good which is not "the greatest good of the greatest number" with concessions to minorities, racial or other, but a good which admits of liberty for the individual to attain full stature, intellectual, moral and social.

THE SYMMETRIC GROUP IN MATHEMATICS

The Theory of Group Characters and Matric Representations of Groups
By Dudley E. Littlewood. Pp. viii + 292. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 20*s*. net.

REPRESENTATION theory is a subject of many aspects, having important contacts with several branches of mathematics and mathematical physics. Even if text-books were much commoner than they are, there would still be room for an introduction to the subject so admirable as this. The very diversity of the theory demands a specialized outlook from those who write concerning it, but within the limits that implies, the account given by Prof. Littlewood is excellent.

From the point of view here taken, the core of the theory is Frobenius's formula for the characters of the symmetric group. The general theory for a finite group is first developed as far as the proof of the orthogonal relations, and there follows a detailed discussion of the symmetric group. Schur functions are also discussed in detail, partly for their own sake, and partly for their applications to the representation theory of continuous groups. This is dealt with in the last two chapters of the book. In the first of these the algebraic representations of the full linear group are found directly ; in the second, the orthogonal relations for groups with closed manifolds are proved, and the characters of the unitary group and of the orthogonal and rotation groups are determined. There are also an account of spin representations, and a brief indication of the necessary modifications for groups leaving invariant an indefinite quadratic form.

The methods employed are chiefly those of Frobenius and Schur. Some use is made of the theory of linear algebras, but the problem of a synthesis of these points of view remains unsolved. The exposition is clear and concise ; but occasionally a more explicit statement of what is being done might have helped. Thus, the work on pp. 51–52 amounts to a proof that any representation of a complete matric algebra is equivalent to a direct sum of identical representations, but this is nowhere stated.

The weakest chapter is an introductory one on linear algebras, which contains errors of fact. In particular, the assertion that the regular representation of an algebra is a simple isomorphism is made without the necessary proviso that the algebra possess a modulus. It is questionable whether the modern habit of including in advanced text-books chapters designed to make them self-contained is of real value. Certainly, a student who tackled the theory of characters without more knowledge of groups and matrices than can be given in such a chapter would be most unwise.

In a book dealing with a theory so largely formal as this, some errors inevitably escape the proof-reader's eye, but the number here is surprisingly small. Altogether, the book is a very welcome addition to the series of Oxford mathematical text-books.

GRAHAM HIGMAN.

GEOLOGICAL BACKGROUND OF ENGINEERING

Geology and Engineering
By Prof. Robert F. Legget. Pp. xviii + 650. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 22*s*. 6*d*. net.

"TRUE engineering is the attainment of the economic solution to the problems faced, and . . . the civil engineer seeks the co-operation of the geologist so that the best advantage can be taken of the rocks to be encountered. . . ." This quotation, which in the text refers to a particular branch of engineering construction, illustrates the author's point of view throughout his book. In order to demonstrate the value of geological and engineering co-operation, Prof. Legget has brought together for the civil engineer and the engineering student a large amount of well-illustrated descriptive material relating to engineering works, from many sources—American, British and Continental. It is one of the most valuable aspects of the book that the assembling of this data in one volume renders easily accessible a body of related facts which, in a border-line subject where science and art overlap and where no two works of construction are exactly alike, must otherwise be sought through an extensive literature.

The book is divided into two parts : an introduction to geology, and geology applied to civil engineering. The first occupies less than a tenth of the whole work and is scarcely sufficient to do justice to the subject ; it seems to assume either some knowledge of geology on the part of the reader, in view of the subsequent use of geological terminology, or a willingness to undertake further extensive reading. It is questionable, therefore, whether this short introduction really serves a useful purpose.

The second and major part of the book (which would be complete without the first) is subdivided according to different branches of the civil engineer's work; it is written in a readable style, against a background of practical experience. Beginning with a discussion of the general aspects of geology in relation to civil engineering, from the training of the student to the preparation of contract plans, the author rightly points out that "there is no special brand of geology applicable to civil engineering", but that a knowledge of fundamental geological principles should be an essential part of the civil engineer's training. Another chapter is devoted to a discussion of exploratory geological work at engineering sites, and deals, *inter alia*, with the question of costs, a matter not often referred to in a work of this kind.

Later sections cover a wide range of topics, including open excavation, landslides, tunnels, bridge foundations, reservoirs and dam foundations, ground water and water supply, building foundations, and materials of construction. Modern methods of applied geophysics are described, with notes on their uses and limitations in connexion with engineering works. The last chapter is headed "Soil and Soil Mechanics", but after a definition of the term 'soil' and a brief statement of methods of soil sampling and testing, there follows a lengthy discussion of rock weathering and glacial deposits, purely geological subjects which would properly belong to Part I; a fuller treatment of soil mechanics itself would be welcome. The modern outlook on clays and clay minerals is also summarized here.

The book concludes with a glossary, appendixes dealing with the geological surveys of English-speaking countries, geological societies and periodicals, and a valuable list of more than three hundred references to literature.

F. G. H. B.

WATER PLANTS

A Manual of Aquatic Plants

By Prof. Norman C. Fassett. Pp. vii+382. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s*.

NOTWITHSTANDING the relative uniformity of their environment, aquatic plants exhibit a remarkable variety of form and constitute a very distinct biological group comprising a considerable number of quite unrelated families. An extensive literature already exists relating to the special features of their morphology and ecology; but apart from monographs on certain genera, the group as a whole has not been analysed systematically with the view of simplifying identification. For various reasons the recognition of aquatic species is not always easy and the present work by Prof. Fassett is intended to make as simple as possible the identification of aquatic plants in sterile as well as in flowering or fruiting conditions. The species included in the Manual are those occurring in the region from Minnesota to Missouri and eastward to the Gulf of St. Lawrence and Virginia. Though the area is thus restricted, many plants are dealt with which are familiar to botanists outside America.

The book is planned so as to provide a series of diagnostic keys by which the student of aquatic biology should be able to identify such plants as he will be likely to find. The text is profusely illustrated by a large number of drawings, the author informing us that "the text is essentially a set of directions for looking at the pictures". The number of illustrations cannot be stated with any exactness since they are not numbered consecutively, but, somewhat inconveniently, in groups varying according to the size of the family. The keys to the Cyperaceæ, for example, are accompanied by 210 figures. Some idea, however, of the wealth of illustration may be gained from the fact that more than half the number of pages are devoted to drawings. They constitute, indeed, a noteworthy feature of the book, and the habit drawings and those showing details of flower and fruit structure are all equally clear and nicely done.

The text of the volume is divided into two parts, Part 1 (pp. 3–35) being a general key for the identification of the family or genus though occasionally it may lead to the actual species. Detailed treatment is given in Part 2 (pp. 36–341), a few pages being devoted to cryptogams before the phanerogams are taken. Vegetative characters are largely used in the construction of the keys, and this has the advantage of directing attention to the features of the whole plant rather than to floral characters alone. The number of species, together with varieties and forms, is surprisingly large in a book which bears the title it does, and Prof.

Fassett has evidently experienced difficulty in deciding where to draw the line between aquatic and terrestrial. For his present purposes he defines an aquatic "as a plant that may, under normal conditions, germinate and grow with at least its base in water and is large enough to be seen with the naked eye", a definition which must inevitably raise difficulties regarding the selection of species. The author admits that the list is highly subjective and that no two botanists would be likely to draw up the same list of species. Many of those included are plants of swamps or wet situations by the margins of lakes or rivers. The bog habitat is said to be excluded, though not a few plants find admission which do, in fact, occur in bogs.

An appendix gives a brief but useful statement regarding the use of aquatic plants by birds and mammals, and the volume concludes with a glossary and index. J. R. Matthews.

AMERICAN APPLIED SYLVICULTURE

Applied Sylviculture in the United States

By Prof. R. H. Westveld. Pp. vii + 567. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 25*s.* net.

THIS book may be regarded as one of the most informative works on some important branches of forestry which has appeared. Carefully prepared for the United States and profusely illustrated, Prof. Westveld's work will well repay a study far outside that country. This is not a treatise on sylviculture pure and simple; the word 'applied' in the title is doubtless intended to correct such a diagnosis.

The author divides his book into eighteen chapters, as follows: i. North-east spruce—hardwood region. ii. New England white pine region. iii. Oak region. iv. Allegheny hardwood—pine—hemlock region. v. Southern Appalachian region. vi. Southern Pine region. vii. Southern Bottomland hardwood region. viii. Central hardwood region. ix. Lake States region. x. Douglas Fir region. xi. Northern Rocky Mountain region. xii. Lodgepoke pine region. xiii. Southwest Ponderosa pine region. xiv. California pine region. xv. Northwest Ponderosa pine region. xvi. Black Hills Ponderosa pine region. xvii. Redwood region. xviii. South-eastern Alaska. The method of treatment of each of these chapters is on similar lines, as follows: *Description:* Location and land ownership, physiographic features, climatic features, development of lumbering, effect of past practices. *The Forests and their Management:* composition and character, stand regeneration and development, windfall, utilization and marketing problems, growth and rotation, financial aspects, application of sylvicultural methods, slash disposal and effects, disease and insect problems, control of animal and logging damage.

Some of the above heads and investigations go beyond the definition of sylviculture as understood in Europe, or, we may add, India, where a correct forestry practice has been in force for nearly eighty years. It might be suggested that even 'applied' sylviculture should not include such distinctive branches of forestry as protection and utilization.

The varied nature of the forestry problems the United States have to face is evidenced by the total areas shown in each of the above chapters as occupied by forests, either national forests, forests owned by the individual States, and those in private ownership—from the great lumbering organizations and other forest-owning private bodies and individuals down to the small farm-lot woodlands.

A very rough analysis of areas gives the following interesting figures. Total area of forests and forest lands (the latter of a varying type in degrade) is approximately 601 million acres. The national forests occupy approximately 150 million acres; the forests of the several States approximately 19 million acres, whilst 432 million acres are occupied by the various categories designated as private forests.

The most informative and fascinating parts of the book are the author's treatment of the sylvicultural problems confronting United States foresters. The forester in India is well aware that, owing to the diversity in climate, typography, and so forth, sylvicultural methods and operations will require different treatment in accordance with the varying conditions and species, etc. The same is true in the United States, with the proviso that conifers (instead of broad-leaved species as in India) cover the preponderating area of the forests, and that lumbering, disastrous fires, and large areas of second-growth forest of very varying uniformity in growth introduce an added complexity to sylvicultural values and their study and treatment. Prof. Westveld has dealt with these problems in a most instructive fashion.

E. P. Stebbing.

FOOD PRODUCTION IN GREAT BRITAIN AND IN WESTERN EUROPE

By Sir John Russell, F.R.S.,
Rothamsted Experimental Station

INFORMATION about food production in Great Britain is readily obtainable from the excellent volumes of statistics issued by the Ministry of Agriculture and the corresponding body in Scotland. Hitherto it has been difficult to compare these results with those obtained in Western Europe; the data of course existed, but they were scattered through many volumes in a variety of languages, and as they were not necessarily comparable there were many pitfalls for the unwary student. Agricultural statistics are particularly troublesome things to handle. The difficulty is largely met by a recently published book by Mr. P. Lamartine Yates, which comes at a most opportune time[*]. The material was assembled and checked on an agricultural journey in 1938, and both the author, and Lord Astor and Mr. Seebohm Rowntree, who were the prime movers in the enterprise, are to be congratulated on its accomplishment.

Mr. Yates deals exhaustively with the Western European countries, France, Belgium, Holland, Denmark, Sweden and Germany, and in his final chapter makes the comparisons with Great Britain. The section on France is particularly interesting, written with understanding, even affection, but faithfully. He recognizes the Frenchman's intense individuality and his dual loyalty to his *pays* or province, and to his *patrie*, France; while these qualities have played their part in the recent *débâcle* they would put serious difficulties in the way of reorganization on German lines with the French as a *race asservie*. One thinks of France as being more agricultural than England and Wales and so far as population is concerned this is true, but not in regard to the use of the land; more land in Great Britain is devoted to agriculture than in France or Germany. The figures are given in Table 1.

TABLE 1.

LAND UTILIZATION PER CENT OF TOTAL AREA.

	England and Wales	France	Germany
Agriculture	67	60	61
Forest	6	20	27
Waste and rough grazing[*] ..	14	10	4
Non-agricultural uses	13	7	8

[*] Waste in France and Germany; rough grazing in England and Wales.

In northern France the chief crops in order of importance are wheat, oats, lucerne, the root crops, potatoes, mangolds, sugar beet, usually grown in a three- or six-course rotation; wheat, oats, lucerne; wheat, oats, roots; less than a quarter of the land is in permanent grass. In the south cereals occupy only about 25 per cent of the arable land, as against 60 per cent in the north, and many special crops are grown: vines, fruit, vegetables, tobacco and maize; some 60 per cent of the land is in permanent grass by reason of its elevation. As in other countries the arable land tends to go down to permanent grass.

France produces about 90 per cent of its wheat requirements, against about 15 per cent in Great Britain; but the yields are lower than in the latter. Potatoes are widely grown far exceeding human requirements, and quantities are fed to pigs; sugar beet is much more localized. As in Great Britain, sheep fell greatly in number after high levels between 1876 and 1896; but the rise which began about 1920 has not gone so far as in Great Britain. Cattle, on the other hand, increased almost continuously in number, and before the War were higher than ever before. Pigs had fallen greatly in number during the War of 1914–18, but rose steadily and before the War were almost at the best of the earlier levels. About 50 per cent of the farmed land is held in 25–125-acre holdings; about 20 per cent in holdings of less than 25 acres and 30 per cent of more than 125 acres. Large farmers are found mainly in the arable regions of the north.

German agriculture is, of course, very different. An east-west line drawn through Cologne, Dresden and Breslau divides Germany into two parts; to the north is the low-lying, almost featureless sandy plain that travellers to Berlin and Warsaw often found rather tedious; to the south are mountains, uplands and forest. The soil of the northern plain is rather poor. In the eastern part the farms are large; 1,000 acres is a usual size, but 10,000 acres is not uncommon. Only some 10–20 per cent of the land is in grass by reason of the low rainfall; rye and potatoes are the chief crops; the potatoes are both for human consumption and for industrial use, and most of the large farmers have their own distillery or starch factory. In north-west Germany farms are small, 50–300 acres, but prosperous; dairying is the chief industry, based on grassland near the coast, and on arable crops farther inland in Westphalia. The south-west is mainly in small holdings; it is a rich country producing fruit and vines, poultry, pigs and milk. Central Germany, the Anhalt region, including Magdeburg and Halle, has larger farms and much sugar beet, while Bavaria produces much milk on its arable plateau and grassy uplands. The utilization of the land is almost the same as in France, excepting that forest occupies 27 per cent and waste only 4 per cent.

---

[*] Food Production in Western Europe: an Economic Survey of Agriculture in Six Countries. By P. Lamartine Yates. Being the Report of an Inquiry organized by Viscount Astor and B. Seebohm Rowntree. Pp. xv+572+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15s. net.

Sixty per cent of the arable land in Germany was (1937) in corn, 22 per cent in roots and 11 per cent in temporary grass; for Great Britain the figures are 50, 25 and 25 per cent respectively (fodder crops and fallows are included with the roots); a typical rotation is roots, corn, corn, which may be followed by grass, corn, corn; for example, on the northern plain one often finds potatoes, rye, oats, but rye is the commonest grain crop occupying 10¼ out of the 28 million acres of grain; it is much better suited to the sandy soil than wheat. As in other countries, there is a tendency to lay down arable land to grass. Since 1914 the percentage of the farmed land used for arable crops has fallen from 75 to 68. Yields of grain are approximately the same as in Great Britain—wheat is a little less, so are potatoes, but yields of sugar beet and hay are higher. Much more labour and fertilizers are expended per acre than in Great Britain, but there is less manuring through the animals than here. Up to 1930 some 25–30 per cent of the animal food was imported as in Great Britain, but since the Nazis came into power great efforts have been made to dispense with importations and substitute home-grown food; considerable success has been achieved. Numbers of livestock are less then they were before the War of 1914–18, sheep indeed having decreased drastically. Pigs are the chief meat producers, furnishing about two thirds of the nation's meat requirements; there are 25 million of them compared with less than 4 million in Great Britain.

The rural population has for years past been falling, but since the advent of the Nazis the fall has greatly increased. At first farm workers were forbidden to leave the land; but in 1936, when industry was short of labour, this prohibition was withdrawn, and during the next three years nearly a million workers went. Then, however, the decree was reimposed and indeed strengthened; the workers in 1939 were practically tied to their occupations. Concurrently efforts were made to reduce the need for labour by increasing the amount of machinery available. There was always a seasonal labour deficit and this was made up by importing farm workers from Poland, Czechoslovakia, Yugoslavia and Italy; the Nazis disliked it because they considered the farm should be a "Germanic entity", free from alien elements. It would be interesting to know how the farms stand now in this respect. In order to ensure a continuance of peasant farming the Farm Inheritance Act of 1933 provided that farms of peasant size could not be sold or subdivided, nor could the owner borrow money on the security of the land; he is in effect tied to his land as it is tied to him. Peasant owners must be racially pure, politically reliable and technically efficient. The heir need not be the eldest son; often indeed he is the youngest.

The agriculture of the smaller and until recently, freer and more productive countries, Denmark, Holland, Belgium and Switzerland is described in "Food Production in Western Europe" in detail, and as one reads the accounts one realizes the depth of the tragedy that has overwhelmed them. All these countries had attained high levels of technical skill and output, but the systematic

Table 2.

Food consumption in lb. per head per annum. (P. Lamartine Yates).

(1934–38)

	Great Britain	Denmark	Netherlands	Belgium	France	Switzerland	Germany
Bread and flour*	197	198	200	250	280	200	222
Potatoes	210	264	—	440	400	198	398
Sugar	109	120	58	62	56	97	56
Beef and veal	66	53	39	40	46	55	34
Pork	48	72	50	45	20	48	65
All meat	143	125	91	90	74	108	100
Milk (gall.)	20	36	26	20	23	58	21
Butter	22	17·2	14·5	20·6	13·3	14·3	16·4
Margarine	8	45	15	10	—	—	15·5
Cheese	9·5	12·1	14	6·4	12·5	18·5	12·6
Eggs (No.)	153	90	100	236	149	156	126

* In terms of flour.

TABLE 3.

AGRICULTURAL OUTPUT 1937. (P. LAMARTINE YATES).

	Output per worker, £		Wages per hired worker, shillings	Acres per worker	Stock units per worker	Output per acre*, £	
	Gross	Net				Gross	Net
Great Britain	240	200	30–36	33·8	10·3	7	6
Denmark	180	155	23–26	15·7	8·4	11	10
Netherlands	150	120	23–30	9·0	4·9	17	14
Belgium	110	100	18–22	7·4	3·4	15	14
Switzerland	110	100	27–29	7·1	4·3	17	15
France	90	90	20–28	11·6	2·8	8	8
Germany	70	70	18–23	7·9	2·8	8	8

* Rough grazings in Great Britain reckoned at half their average, and Alpine grazings in Switzerland at one quarter.

plundering to which Denmark, Holland and Belgium are now being subjected will gravely impoverish them for years. They were far ahead of Germany in output per man and in output per acre. Unfortunately, their prosperity aroused Nazi covetousness and proved their undoing. In pre-War days they had sent Great Britain quantities of food, notably butter, eggs, bacon, early vegetables and certain fruits. In war-time these supplies are all cut off, and so far as they still exist are deflected to Germany. But much of the intensiveness of their agriculture was due to the importation of large quantities of feeding stuffs and fertilizers, most of which are no longer obtainable; their output will therefore be considerably lowered.

British farmers have a much more difficult task than confronts the Continental and particularly the German farmer. The peace-time dietaries of the Western European countries are stated by Mr. Yates as in Table 2.

The English dietary included considerably more meat (especially beef and mutton), sugar, butter, fruit and vegetables than the German, but only half the potatoes and 12 per cent less bread. On average British yields, 1·6 acres are necessary to produce the food of the British consumer unit; the limited land area can at this rate feed only 40 per cent of the British people. The German dietary, on the other hand, requires little more than half this land per head, and as Germany has twice the area of agricultural land that Great Britain has, but less than double the population of the latter, it is not surprising that they can attain more than 90 per cent of self-sufficiency against 40 per cent in Great Britain. Indeed the more one studies the two systems the more one realizes how superior the German is for war-time. Moreover, the details have been well worked out. Thus in spite of the fact that the pig is the most economic transformer of food into meat, Great Britain will have to reduce her pig population while retaining her sheep and cattle, because pigs consume food suitable for milk production or for human beings, while sheep and cattle do not. The German farmer will be able to keep many of his pigs, for a system of feeding has been worked out that requires much less concentrated food. Other technical difficulties had also been met; indeed so long as the Germans can draw forced labour and agricultural produce from surrounding countries they cannot be starved out, although they can be made uncomfortable.

The British farmers' activities have been in quite a different direction. In the years that followed the War of 1914–18, when but little interest was taken in agriculture, the farmer's task was to survive and to meet the rising costs of wages resulting from the competition of industries moving southwards. He solved the problem by increasing his own efficiency and that of the workers. Mr. Yates's figures showing the relative output per worker in the different countries' areas are given in Table 3.

The net output of the British agricultural worker is three times that of the French or German; the gross output is still higher. No other European country begins to equal Britain in this respect. But this high output per man has not given us high output per acre. In some ways the two things are opposed, and countries of high output per man frequently have low output per acre. The relation, however, is not rigid, and it is possible to achieve high output per acre and high output per man; that is the problem now confronting British agriculturists. There is no evidence that it can be done simply by enlarging our farming units; the countries that far surpass us in output per acre are all lands of small holders. But there is also no evidence that the setting up of small holdings would give any better result; in spite of considerable public expenditure on small holdings the numbers have continuously shrunk. The reorganization must be in the direction of making fuller use of the technical and scientific knowledge now or in future available so as to increase the efficiency of the land as well as that of the worker. The crux of the problem lies in the uncertainty of prices of agricultural produce. Farmers have to start spending money on crops and stock many months before the produce can be sold, and in the meantime prices may have fallen considerably. Farmers cannot take indefinite financial risks and must play for safety. No other producers of commodities are in so insecure a position; all, except farmers, are always protected by contracts.

A similar arrangement seems indicated for agriculture. The total food requirements of the nation are fairly accurately known; it should not be difficult to allocate them to the various supplying countries and so to settle what should be the share of the British farmer. Contracts could then be made; the farmer to supply specified quantities, and the buying agency to pay specified prices which should move, however, with wages, since these are fixed by statutory bodies. Arrangements of this kind have for some time been in force for milk, sugar beet and wheat, and have led to the adoption of improved methods and increased output. The same principle is being tried for meat, a much more important farm product. Of course, it means a certain amount of planning, but this seems inevitable in our national life after the War. Our fundamental problem will be to reconcile planning with the liberty which none of us would be prepared to give up, but this certainly should not prove insoluble.

ANCIENT MESOPOTAMIA AND THE BEGINNINGS OF SCIENCE*

By Prof. E. A. Speiser,
University of Pennsylvania

THE thesis which it is proposed to outline here embodies the following propositions: (1) Available evidence points to Mesopotamia as the oldest known centre of scientific observation permanently recorded. (2) Whatever its immediate objectives, this activity comes to include such widely separated fields as education and language study, jurisprudence, and the mathematical and natural sciences. (3) The numerous elements in this broad advance are interrelated basically. The common underlying factor to which the initial impetus can be traced is a concept of society whereby the powers of the State are restricted and the rights of the individual receive a corresponding emphasis. (4) It is significant that under the opposite social system of totalitarian Egypt early scientific development differed in scope as well as in degree; while notable in certain special fields, such as medicine and engineering, it lacks the breadth and balance manifested in contemporary Mesopotamia.

There were certain features in protohistoric Mesopotamia which tended to encourage scientific progress. The results happen to constitute the first recorded evidence of scientific performance known to us to-day. To this extent we are justified in touching here upon the beginnings of science, including the natural sciences. But it should be made clear at the outset I am concerned not so much with the results as with the background; a combination of circumstances conducive to concerted activity rather than the subjects affected by that activity. The background gives us in this instance the essential starting point; it is thus more significant than the immediate achievement.

Our interest, then, centres on a particular cultural stage at which there were at work forces that led to extensive scientific developments; forces which provided the predisposition, so to speak, to these developments. Accordingly, we shall ignore such sporadic achievements of a still more remote age as the invention of the wheel, the introduction of the brick-mould, and perhaps the use of instruments in effecting accurate geometric designs on very early forms of painted pottery. We may have here Mesopotamian inventions which were to play important parts in the eventful progress of engineering, architecture, and perhaps geometry; but these inventions represent isolated contributions of discontinuous cultures which scarcely had any immediate bearing on scientific progress.

The region to which our inquiry will take us is Lower Mesopotamia, the land of ancient Sumer. More specifically, it is an area extending south-west from the environs of Babylon, past Uruk—the biblical Erech—and on along the Euphrates to the metropolis of Ur. The time is the middle of the fourth millennium B.C. This is not just a convenient round figure. It will allow a margin of scarcely more than a century, and in a total of more than five thousand years this is not a disproportionate margin of error. We are in a position to establish the time with such accuracy because it falls within a well-stratified cultural period marked off sharply by distinctive material remains. Soon after there begin to appear inscribed records which link up before long with concrete regnal years and provide thus a basis for absolute chronology.

---

* Substance of a paper read at the Bicentennial Conference, University of Pennsylvania, on September 16.

We get our first inscribed documents from a level dated to shortly after 3500 B.C., one of a long series of strata recovered from the remains of ancient Uruk. It is among these documents, written on clay, that we find a few which represent the earliest known scientific records. That similar records of still greater antiquity will ever turn up outside Mesopotamia is highly improbable. All available evidence points to the conclusion that the scientific notations with which we are concerned were compiled in close association with the introduction of writing itself. To be sure, this evidence applies only to the script of Mesopotamia. But writing in all the other ancient centres of civilization is demonstrably later. In Egypt it was introduced some centuries after it had been evolved in Mesopotamia, and its first appearance in India was later still. As for the script of China, there is nothing to indicate that it was earlier than the second millennium B.C. It follows, therefore, that the scientific notations on our earliest Mesopotamian tablets constitute not only the first evidence of scientific activity in Sumer, but represent also the oldest recorded effort of this kind known from anywhere in the world.

What is it that would justify the use of the term 'scientific' as applied to a few of the oldest inscribed documents from Mesopotamia ? The answer is bound up with the character and purpose of these special texts. Each of them contains lists of related entries. But these lists have nothing in common with the customary inventories of a strictly economic nature. They serve an intellectual rather than a material purpose ; and yet, they are to enjoy a continuity and distribution which will set them off sharply from the usual run of business documents the significance of which is at once temporary and local. The lists in question are destined to be copied and recopied for many centuries and in more than one city and country. Actual examples of such copies, often modified and expanded, but still in a clear line of descent from the oldest prototypes, have been discovered in Mesopotamian sites of much later age, and even in foreign capitals like Elamite Susa. We have thus before us the beginning of a family of documents of a scholarly character which are notable for their continuity, distribution, and purposeful adherence to an established tradition[1].

In this recording of accumulating experience and the manifest applicability of such records to the needs of cultural centres separated by political, linguistic, and chronological barriers we have the essential ingredients of scientific performance. Now what science or sciences did this activity embrace ? We shall see presently that the primary purpose of the lists under discussion was to aid in the preservation of the knowledge of writing. Before long, philological studies become an added objective, owing largely to the composite ethnic and linguistic background of early historic Mesopotamia.

Natural sciences, too, soon get attention. For regardless of the primary purpose of these lists, they happen to include quite early in their history groupings of birds, fish, domestic animals, plants, and the like. It is worth stressing that these compilations presuppose careful observation and imply organization and analysis of the accumulated data[2]. As an element in the cumulative tradition of the land the lists are subject to steady expansion and improvement. What is more, although these texts were calculated originally to serve purposes unrelated to their subject-matter, they lead in course of time to the independent study of the subject matter involved. The fields affected are zoology and botany, and later on geology and chemistry. The first recognition of all these subjects as so many separate fields of study may be traced back, therefore, to the earliest inscribed documents from Mesopotamia.

The subsequent progress of the individual sciences just mentioned has to be traced by specialists. We are concerned at present with the initial impetus alone, and the time and circumstances in which that impetus was first received. A few details, however, may be brought out in passing. In the light of the foregoing remarks botanists will not be surprised to learn that many of the terms which they use to-day are found in Mesopotamian sources. These terms include cassia (cuneiform *kasû*), chicory (*kukru*), cumin (*kamûnu*), crocus (*kurkânû*), hyssop (*zûpu*), myrrh (*murru*) nard (*lardu*), saffron (*azupirânîtu*), and probably many others. The zoological compilations which are accessible in cuneiform records contain hundreds of names systematically arranged and presented in two columns, the first giving the Sumerian term and the other its Akkadian equivalent[3]. The scholastic tradition in chemistry results in such texts as the one which has come down to us from the second millennium B.C., wherein a formula for glazing pottery is preserved in the guise of a crypotogram so as to remain hidden from the uninitiated[5]. The importance of natural science for the study of medicine is self-evident ; it was not lost on Babylonian and Assyrian medicine.

So much for the indirect benefits derived from the lists under discussion. But the primary objective of these compilations was not allowed to suffer in the meantime. On the contrary, the direct results which were achieved with their aid led to an immensely fruitful advance in another field of intellectual progress.

It was stated above that the lists were intended as a means of preserving the newly attained knowledge of script. By the very nature of its origin in concrete pictographs, early writing was an elaborate medium consisting of thousands of items. To each new prospective user it represented a code which could not be deciphered without a proper key. The lists were calculated to supply that key. They were analytical catalogues of signs arranged according to form. Inasmuch as each sign was at first a reflection of something specific in the material world, these catalogues were at the same time systematic groupings of related objects; hence their incidental value to the natural sciences, as we have just seen. The immediate purpose, however, of these arrangements was pedagogical; they are our oldest manuals for the discipline of education. As pictographs and ideograms gradually took on abstract phonetic values, the study of the script became linked perforce with the study of language. After the Semitic-speaking Akkadians had joined the Sumerians in building up the civilization of Mesopotamia, linguistic studies rose to exceptional heights against this bilingual background.

The foregoing outline shows that many forms of scientific progress in Mesopotamia were influenced and linked together by a scholarly tradition which was in turn the by-product of the invention of writing. Our survey has failed, however, thus far to include mathematics and astronomy, two fields for which Mesopotamia has long been celebrated. It need scarcely be said that these subjects were affected no less than the other disciplines by the same forces which made for a broad cultural advance in general. But the primary cause of the extraordinary development of mathematical and related studies in Mesopotamia is to be sought, I believe, in conditions which antedate the introduction of writing. In fact, I would add, the origin of writing as well as the interest in mathematics are to be traced back, in this case, to a common source. This source will be found inherent in the society and economy of the prehistoric Sumerians.

We know to-day that the Sumerians got their idea of writing from the cylinder seals which they engraved with various designs to serve as personal symbols. These symbols came to be employed as marks of identification for religious and economic purposes, for example, with temple offerings. In this representational function the old designs develop into concrete graphs for humans, animals, plants, and so forth, and thence for temples, gods, and cities. The graphs are then associated in each instance with specific words. The gap between picture and word is bridged. Gradually means are devised to express not only complete words but also component syllables, the advance leading thus from the concrete to the abstract. At length writing is perfected to function as a flexible medium for the recording of speech and thought[5].

When we look back now on the successive interlocking stages in this complicated process, which has been sketched here in its barest outlines, an interesting fact will emerge. The early Sumerians had not set out at all to invent writing. They were carried to this result by a combination of peculiar circumstances.

We have seen that the immediate ancestor of Mesopotamian writing was the cylinder seal which was first and foremost the Sumerian's mark of ownership. Impressed on clay or cloth it served to safeguard in the eyes of god and man one's title to possessions or merchandise. We have here a clear indication of a strongly developed sense of private property and thereby of individual rights and individual initiative[6]. The curious shape of the cylinder seal, original with the Sumerians, is explained by its use as a mark of individual ownership. For such cylindrical objects are well suited to cover uneven surfaces with their distinctive design[7].

Wholly consistent with this economic origin of writing is the fact that the earliest written documents are given over to temple economy. Later texts branch out into the field of private business. Both these uses testify independently to the importance attaching to property rights. Records of a non-economic character are the last to appear, except for the lists discussed above, which served as direct aids to writing. The first inscribed documents were used, accordingly, for economic ends, precisely as the cylinder seals themselves. It is easy to understand why the oldest pictographs were so often identical with the designs on the seals.

It follows that Mesopotamian writing, and hence the first script known to man, was the unforeseen outgrowth of a social order which was founded on a recognition of personal rights. This basic feature of Sumerian society is attested overwhelmingly in cuneiform law, perhaps the most characteristic and the most abundant expression of ancient Mesopotamian civilization. In the last analysis this law rests on individual rights. It is not surprising, therefore, that proof of ownership becomes a vital necessity under this system. Incidentally, the rigid requirement of such proof is the main reason for the hundreds of thousands of legal documents recovered from the buried sites of

Mesopotamia; the forces responsible for the introduction of writing continued thus as the primary factor in the subsequent popularity of script. The law applies to ruler and subjects alike. The king is at first no more than a 'great man', as is shown by the Sumerian etymology of the term as well as the form of the corresponding pictograph. He may become the administrator of a vast empire; but even then he is still the servant, not the source of the law, and is responsible to the gods for its enactment. There is here no encouragement of absolute power. Law codes are the constitution which guides the ruler and safeguards the subjects. We have seen that this system is capable of promoting cultural progress on an extensive scale. Its inherent vitality is evidenced by the ease with which this order maintains itself for thousands of years in spite of a succession of political changes under the Sumerians, Akkadians, Gutians, Babylonians, Kassites, and Assyrians. Nor is further expansion hindered by ethnic or linguistic obstacles in its path; for distant and heterogeneous outsiders are attracted not infrequently to the orbit of the Mesopotamian civilization. Among the newcomers we find the Elamites, the Hurrians, and the Hittites, the last-named a people of European ancestry and Indo-European speech. Incidentally, it is to the influence of Mesopotamia upon the Hittites that we owe to-day our oldest available records of any Indo-European language. The newcomers proceed to copy the laws, use the script, and enjoy the other benefits of the adopted civilization.

Enough has been said to imply that mathematics and time-reckoning were bound to prosper against this social and economic background. An obvious corollary is preoccupation with metrology, with the result that Mesopotamian weights and measures spread eventually beyond the domain of the parent culture[8].

To sum up, there existed an intimate relation between scientific progress in Mesopotamia and the source of historic Mesopotamian civilization. Underlying all was a social order resting on the rights of the individual, embodied in a competitive economy, and protected by the supreme authority of the law. This system brought about the evolution of writing, henceforward a decisive factor in the advance of civilization and its diffusion past the changing ethnic and political boundaries. We have here the essentials of a truly cosmopolitan civilization, notable for its assimilatory power and a science broad in scope and balanced through the inner unity of its many branches.

Would this story of scientific development have differed appreciably under another type of civilization? The answer is hinted at in one of history's most magnificent experiments. The one centre possessing a culture of comparable antiquity but dissimilar social and economic background was Egypt. Here the king was a god and as such the absolute ruler and titular owner of all that his realm contained. Under this concept of government there was no room for the recognition of private ownership of property and the all-embracing power of the law. The pharaoh was dictator of a State genuinely and thoroughly totalitarian. The pyramids bear lasting and eloquent testimony to his enormous authority.

We are not concerned here with the respective merits of two contrasting forms of government. Our interest is confined for the present to the effect of co-existent civilizations upon the progress of science in the two centres under comparison. The perspective of more than five thousand years cannot but deepen our appreciation of the debt which modern life owes to both Egypt and Mesopotamia. By the same token, however, we are able now to view objectively some of the differences between their respective achievements.

The established superiority of Mesopotamian mathematics may be attributed, in part at least, to the stimulus of the local economy, so different from the Egyptian. Opposed concepts of property ownership and the fundamental rights of the individual were responsible for the intensive pursuit of legal studies in the one instance and their subsidiary role in the other. The astounding accomplishment of Mesopotamia in the field of linguistics had no adequate counterpart in Egypt. Now we have seen that in Mesopotamia progress in linguistic studies, not to cite now other branches of science, was linked intimately with the development of writing. But was not Egyptian writing a correspondingly potent factor?

If this question cannot be answered with complete confidence it is largely because the origin of the Egyptian form of script is still open to conjecture. Some details, however, are certain and beyond dispute. The earliest inscribed records of Egypt are some centuries later than the first written documents of Mesopotamia. In Sumer we can follow the successive palæographic stages step by step, whereas in Egypt the formative period of writing seems to have been very short indeed, to judge from the available material. Moreover, writing left in Sumer a clearly marked trail which leads back to a specific social and economic set-up; in Egypt there is no such demonstrable relationship. Because of all these facts, and in view also of commercial and cultural links known to have connected Egypt and Mesopotamia at the very period under discussion, it is logical to assume that Egypt imported the idea of writing from Mesopotamia. Differences in the form and use of the signs would correspond, then, to the existing differences in the art and languages of the two cultural centres. On present evidence, any other assumption would leave far too much to coincidence[9]. In the final analysis it is not so much a question of the mere use of script as of the conditions responsible for the original emergence of writing.

At all events, Egyptian writing, regardless of its origin, inevitably played its part in the notable progress of Egyptian science. What we miss here, however, is the scope and inner unity of scientific advance which are found to be so characteristic of Mesopotamia. That unity was the product of a tradition which is traceable ultimately to a particular concept of life. In totalitarian Egypt a different set of values attached to life and government and tradition. Is this the reason for an effort that seems more sporadic, greater perhaps in its power of concentration on specific objectives, but also more conspicuous for its omissions? Over a period of millennia this appears to be a justifiable comparative appraisal of the results achieved in the field of science by the two oldest historic civilizations.

---

[1] These facts are brought out clearly by A. Falkenstein, whose "Archaische Texte aus Uruk" (Berlin, 1936) is the basic work on the earliest documents from Mesopotamia; cf. especially pp. 43 ff.

[2] Careful observation is evidenced also by the accurate drawings of the early pictographs, particularly where exotic animals and specific plants were concerned.

[3] See Benno Landsberger (in co-operation with I. Krumbiegel), "Die Fauna des alten Mesopotamien" (Leipzig, 1934).

[4] On this subject see R. Campbell Thompson, "A Dictionary of Assyrian Chemistry and Geology" (Oxford, 1936).

[5] R. Campbell Thompson and C. J. Gadd, in *Iraq*, **3**, 87 ff. (1936).

[6] Cf. E. A. Speiser, "The Beginnings of Civilization in Mesopotamia," *J. Amer. Oriental Soc.*, Supp. 4, **59**, 17 ff., esp. 25–28 (1939).

[7] See H. Frankford, "Cylinder Seals" (London, 1939), p. 2.

[8] Note the article by V. Gordon Childe, on "The Oriental Background of European Science", *Mod. Quarterly*, **1**, No. 2, 105 ff. (1938).

[9] Cf. Speiser, *op. cit.*, 22, note 12, and Siegfried Schott, in Kurt Sethe's "Vom Bilde zum Buchstaben" (1939), pp. 81 ff.

BROADCASTING IN INDIA

THE task of providing an efficient radio broadcasting service in the Indian Empire is beset with many problems which are peculiar to that country and which other broadcasting organizations in Europe and America have not encountered. India is a country of relatively great distances and a vast population, most of whom have a rather low standard of living. Nearly thirty times the area of England, the population numbers more than 300 millions, speaking some 200 different languages, of which about 16 are in common use. From a technical point of view India is subject to a frequent and very high atmospheric disturbance level, and this calls for special consideration in the choice of wave-length and power of the transmitting stations, if a satisfactory programme service free from interference is to be obtained. Furthermore, it was clear many years ago that a broadcasting service could not be built up out of licence revenue as was done in Great Britain. These and other problems have occupied the attention of the Government of India over the past thirteen years, since the first broadcasting station was opened at Bombay by Lord Irwin in July 1927. In his speech on this occasion the Viceroy indicated that India offered special opportunities for the development of broadcasting, and that although it was then in its infancy, he had little doubt that, before many years had passed, the numbers of its audience would have increased very considerably and that this new application of science would have its devotees in every part of India.

The long and varied struggle which the Indian State Broadcasting Service has had since the date mentioned above is recounted in a recent publication from Delhi entitled "Report on the Progress of Broadcasting in India, up to the 31st March 1939"*. A second broadcasting station was opened at Calcutta in 1927, by the end of which year the number of licensed listeners was less than 3,600. Although this number was soon doubled, the rate of increase remained sensibly unaltered from 1929 until 1932, when the inauguration of the Empire Service of the British Broadcasting Corporation led to a sharp rise in the rate of increase to more than 16,000 listeners by the end of 1934, although there were still in operation at this time only the two broadcasting stations already mentioned. Soon after this time, the first Controller of Broadcasting of the Government of India assumed charge of the organization known as All India Radio, and set to work to develop broadcasting into a service appropriate to the needs of the country. In view of the lack of technical experts in India with any long experience in broadcast engineering, considerable assistance was obtained in this connexion from the B.B.C. in Great Britain.

The development policy, upon which work has been actively progressing during the last two or three years covered by the report, envisaged the establishment of nine medium-wave stations and five short-wave stations, one of which, situated at Delhi, was specially assigned for the transmission of news from a central point. The basis of the scheme of using medium-wave stations operating on wave-lengths between 200 and 400 metres followed the experience gained in Europe and

* Report on the Progress of Broadcasting in India up to the 31st March 1939. Pp. xiv+230+21 plates. (Delhi: Manager of Publications, 1940.) 3 rupees; 5*s*.

America, and it was considered that the nine stations projected would provide a first-grade medium-wave service at important centres of population. In order to reach the rural population, however, it is necessary to spread the service over relatively great distances and this factor, together with the prevalence of some atmospheric disturbances, led to the supplementary scheme of the provision of short-wave transmitting stations. The application of short wave-lengths to Indian broadcasting differs in one very important aspect from the application made by European countries, in so far as in India the short-waves were required for an internal broadcasting service, whereas in European countries the short-wave service is primarily intended for overseas listeners. This difference in requirements leads to the use of different wave-length bands in the two cases, and therefore fortunately to an absence of interference. The Indian short-wave stations normally operate in the day-time in the wave-length bands of 30 and 49 metres, which are used by the European international stations only at night; while in India at night, the wave-length bands of 60 and 90 metres are utilized, and these are not used by broadcasting stations operating an international service.

At the inauguration of the above scheme, it was estimated that if the short-wave transmitters were of a power rating of 10 kilowatts they would have an intelligible, if not satisfactory, service range of about 500 miles. The four stations projected for general use could therefore be regarded as covering the whole of India, and providing a service which, if not entirely free from fading, would be not unsatisfactory to the average listener. The installation of four such stations instead of one high-power medium-wave station possessed a marked advantage in providing the possibility of alternative programmes which, owing to difficulties arising from timings, languages, Indian and European music and so forth, would clearly be very desirable. During the years 1937 and 1938 the four short-wave stations came into operation, and these, together with the new and already established medium-wave stations, resulted in twelve of the fourteen projected stations being in service use at the date of presentation of the report referred to above. The whole scheme was financed by a capital grant from the Government of some £300,000, from which a balance of about £120,000 remained on April 1, 1939. The overall annual expenditure of the All India Radio organization has risen steadily to nearly £190,000 for the year 1938–39.

In the early days, the engineering and technical control of broadcasting in India was conducted by the Posts and Telegraphs Department. Afterwards these activities were transferred to All India Radio under the Controller of Broadcasting, in order to avoid the admitted difficulties of divided control between administration and programmes and engineering. Considerable space is given in the Controller's report to the activities of the Engineering Department, which is concerned mainly with the maintenance and operation of existing broadcasting stations; the planning and installation of new broadcasting centres; and with development and research work of a technical nature.

Any broadcasting system must make extensive use of direct connexions between the various stations so that programmes originating at one station may be radiated from others. These connexions are usually effected by telephone lines suitably designed and installed for the purpose; but in India they present a special problem owing to the immense distances separating the broadcasting stations and the general unsuitability of the telephone lines and associated apparatus. All India Radio has consequently developed a system of wireless links whereby each broadcasting station is provided with a receiving centre equipped with special directional aerials for accepting programmes from the desired stations. These receiving centres are used principally for picking up the short-wave transmissions of All India Radio and of the B.B.C., and relaying these from the local transmitter. In the same way the news bulletins of the Central News Organization at Delhi will, as receiving centres are established, be received and relayed by all stations in the system. The main receiving centre on the outskirts of New Delhi was installed and working on a temporary basis just in time to relay the Coronation ceremony broadcast by the B.B.C. in May 1937. The installation utilizes a combination of three directional aerials for diversity reception to minimize the fading commonly experienced in short-wave broadcasting. The New Delhi receiving station also acts as a main control centre where a watch is kept on the wave-length, field strength and quality of the transmissions from stations of the All India Radio.

Among the more important activities of the research department of the organization is a study of the field strength of the transmissions from the various stations and of the service area of each station as determined by the ratio of the field strength of the signal to the strength of the disturbing noise. Much useful material on these subjects is given in the report under discussion, but only one or two outstanding points can be referred to here. One interesting fact emerging from the measurement of the field strength of the radiation from the various medium-wave stations is that the decrease in intensity of the ground wave with increasing distance from the transmitter shows that the conductivity of the soil in India is of the same order as that obtained under average conditions in England (that is, between 1 and 2 × 10^8 E.S.U. or 4,500–9,000 ohm-cm.). In addition to a study of ground wave conditions, measurements have also been carried out at night time on the indirect ray field strengths of the medium-wave stations. The results show that, with one or two exceptions that remain for further investigation, the relation between distance and field strength of these stations approaches the curve published by the C.C.I.R. (International Committee on Radio Communication), which is based upon a very large number of measurements made by broadcasting organizations in various parts of the world. This fact indicates that the conditions of medium-wave propagation through the ionosphere in India are not appreciably different from those in other parts of the world.

As already mentioned, the effective service area of a broadcasting station is determined by the ratio of the strength of the wanted signal to that of the unwanted noise. During the summer months of May–October, atmospheric disturbances represent the greatest single technical difficulty to be met with in India in providing a satisfactory broadcasting service, especially on the medium wave-length band. It is natural, therefore, to find that a considerable study is being made into the nature and origin of atmospheric disturbances. It is interesting to observe, however, that on the short wave-length bands, the service area of the Indian broadcasting stations is at present limited by the noise from electrical machinery and not by atmospherics. By far the most serious limitations on short-wave reception in India is the noise resulting from the operation of ceiling fans from a direct-current supply. In practically every city in India a D.C. supply only is available, and only in the large cities is a gradual change-over to alternating current supply being made. During the summer months, for a greater part of the twenty-four hours, there is a number of D.C. motor-driven fans in operation, and in many of these the commutator is in an unsatisfactory condition and hence causes serious disturbance.

As a conclusion to this review of the present state of broadcasting in India, reference will be made to a somewhat unusual activity of a broadcasting organization, namely, the design, supply and maintenance of a communal receiver for use by a considerable proportion of the rural population. From what has been stated earlier in this article it will have been appreciated that, apart from a few towns and suburbs, the broadcasting service in India is maintained by means of indirect rays propagated through the ionosphere, and if all-the-year-round reception is desired, the receiver must be one of the short-wave type, which is by no means cheap. The bulk of India's population live in villages, and it is considered that nearly 99 per cent of them cannot afford to buy any radio receiver, however reasonable its cost may be. The only solution to this economic difficulty appeared to be the installation of community receivers and the provision of special programmes for the villages. A number of such receivers has been installed by, and maintained at the expense of, the Governments of the individual provinces and are very successful.

As a number of difficulties were met with in the earlier stages of the inauguration of the village receiver scheme, a study of the technical points involved was made by the Research Department of All India Radio. After adequate investigation of the requirements, a specially designed receiver was evolved which, while following the general trend of commercial practice, incorporated certain additions and modifications. The receiver is of a straightforward superheterodyne type suitable for operation from a 6-volt car accumulator. In the comparatively few cases where an alternating current electric main supply is available a suitable alternative type can be provided. The two main requirements involved in the design of these receivers are reliability of operation and economy, since it is desired that they shall work automatically with only occasional attention by skilled technical personnel.

The receivers themselves are mounted in padlocked metal boxes, designed to keep out dust and insects. No controls appear on the outside of the box, and the receiver is left tuned to the local station. A clockwork-driven time-switch, incorporated in the set, switches the receiver on and off at the correct time for the "Village Hour" of broadcasting. Special attention has been given to the loud-speaker, which has been designed to have a high electrical acoustical conversion efficiency, to be free from the ravages of dust and moisture, and to give an adequate output of reasonable quality suitable for an audience of some two hundred listeners. The present type of receiver can be run from a medium-size car battery for a month on the basis of one hour's listening per day. Every three or four weeks the battery is charged and the clock re-wound. Installations of this type varying from fifteen to a hundred and twenty receivers in various provinces are in process of completion. In this manner, the full possibilities of community listening in numerous villages are being explored in an attempt to make broadcasting available to as great a proportion of the population of India as possible.

NEWS AND VIEWS

Islamic Culture in London

THE announcement by Mr. G. N. Hall, Under-Secretary of State in the Colonial Office, in the House of Commons on November 13 that the Government at an early opportunity would invite Parliament to vote a sum not exceeding £100,000 for the purchase of a site for the erection of a mosque and centre of Islamic culture is one which has caused intense gratification to Moslems in Great Britain, and will be deeply appreciated throughout the Moslem world. The need has long been felt for an adequate centre of this kind at which Moslems in Great Britain might offer their prayers, develop Islamic culture and preserve their religious tradition. His Excellency Hassan Nashaat, Egyptian Ambassador in London, in announcing the gift by broadcast in Arabic "to my brothers in Islam" as reported in *The Observer* of November 17, appealed to the Moslem world for a sum of £500,000 towards the building fund, having previously given an assurance that this great centre of Islamic culture would belong to the whole Moslem world and would be controlled by its representatives irrespective of sect or denomination. The gift from the British Government, as was suggested in a reply by Mr. Hall to a supplementary question, in a sense is reciprocal to a gift from the Egyptian Government some years ago, when the site for a cathedral was presented to the British community in Egypt.

Conditions in Air Raid Shelters

THE committee appointed jointly by the Minister of Health and the Minister of Home Security in September last, under the chairmanship of Lord Horder, made its first recommendations within a few days of its appointment and has continued to give advice from time to time. Further recommendations, with brief statements by the Ministry concerned of action already taken, have now been issued (London: H.M. Stationery Office. 2*d.* net). The Committee states that the crux of the problem is overcrowding, which should be countered by popularizing the domestic and communal shelters, and also by vigorously pursuing evacuation schemes already in operation. The other recommendations refer mainly to the provision of amenities, such as bunks, lighting and sanitary arrangements, and of first aid posts. On the thorny question of heating, the Committee points out that it is closely related to ventilation. The ideal solution would be air-conditioning, but as this is not practicable, ventilation by natural means is assumed. All ventilation shafts and other means for the entrance and exit of air should obviously be kept free, and floor draughts should be controlled by arranging for incoming air to be admitted at high levels so that it may mix with warm air. Shelters liable to crowding do not require heating even in winter, but sparsely occupied shelters might be heated during the latter part of the day-time. Air-borne infections may be reduced by spraying with a solution of sodium hypochlorite, and innoculation against diphtheria should be encouraged. A simple form of face mask would help to prevent the spread of droplet infection by coughing and sneezing.

Psychology in War-time

IT is reported by Science Service that at a recent meeting of the South Psychiatric Association held at Jacksonville, Florida, Dr. C. Charles Burlingame, of Hartford, Conn., discussed the Nazi utilization of applied psychology in warfare. Dr. Burlingame pointed out that Hitler is mentally abnormal, but because he is a hysteric, it must not be assumed that his thinking is not lucid; for he has successfully used the psychological factors of modern warfare to produce mass depressions and mass anxieties in whole nations. In dealing with him, the statesmen of the world have made the grave and tragic error of assuming that he was a normal man, whereas almost any psychiatrist would have known that he could not be expected to function or react in a normal way. Psychology can, however, make a positive contribution to the task of ridding the world of Nazism. In times of war, all the paranoid trends come to the surface; in other words, the primitive brain which supplies the drive and co-ordinates the activities, but lacks the ability to formulate abstract principles, is apt to take charge. This is shown by outbreaks of persecutions and terrorism; such outbreaks are a sign of weakness. Germany will grow progressively weaker as her hatred grows stronger and then suddenly transforms itself into despair and depression. It is the duty of psychiatrists to ward off such outbreaks. They can also watch for possible social gains in times of war; many youths whom medical men would classify as 'unstable' might find a new life in the Army, where under intelligent discipline, with security and regular direction, they may become useful citizens.

Production of Feeding-Stuffs in Great Britain

SUPPLEMENTING his study of Britain's supplies of feeding-stuffs from all sources (see NATURE, Sept. 14, p. 362), Dr. Norman Wright has investigated quantitatively the problem of making good war-time deficiencies by using new sources of indigenous materials and by improved conservation of all supplies (*Agric. Prog.*, 17, Pt. 2). He finds that conservation of all slaughter-house offals would only just offset the greatly diminished supplies of fish-meal, and that large-scale utilization of kitchen waste would provide a mere fraction of our requirements. Of greater significance is the officially projected production of one million tons of grass silage, but this amount would involve the construction of about 30,000 silos, each of 30–35 tons capacity; and if ten per cent of the straw not used for stock-feeding were converted into a digestible cellulosic feed by predigestion with alkali, more than 20,000 digestion tanks and about 22,000 tons of caustic soda would be required.

Neither the direct use of urea or ammonium bicarbonate to make good the protein deficiency in cereal and other starchy foods, nor the doubling of the existing acreage under beans, would appreciably add to our resources in protein materials. More hopeful would be the economizing of imported feeding-stuffs by adopting the Lehmann system of pig-feeding (restricting the cereal meals and using more boiled roots, potatoes, etc.); the reduction in the protein ration of dairy cows from 0·6 lb. to 0·5 lb. protein equivalent per gallon of milk; and by putting all poultry on minimum feeding allowances. These savings would represent about three times those to be secured from possible new sources of supply. The total savings from all sources would represent 11·7 per cent protein equivalent and 8·9 per cent starch equivalent of our pre-War home production, but only 8·5 and 6·9 per cent, respectively, of our total pre-War supplies.

The Pharmaceutical Society's New House

The Pharmaceutical Society's building in London was nearing completion when the exigencies of the War brought about a suspension of the final stage of the building operations, and so prejudiced the intention of celebrating the centenary in a new home. The council of the Society, having in mind the fact that the lease of the old building in Bloomsbury Square will expire in due course, is approaching the Ministry of Works with the proposal that, in return for facilities being granted to finish the building, the Government should have the option of the use of it during the present emergency. This offer may raise the general question of the attitude of the Government regarding large modern buildings in London which are nearing completion.

The Society's new building has a frontage of 235 ft. and a site depth of 120 ft.; it is designed to provide a basement, ground floor and five upper stories, and the total available floor area which could be provided would be more than 141,000 square feet. The main front block and the west and centre wings have been erected up to the fourth floor level. The east block remains to be built from above basement level. The building is of steel frame construction with panel walls finished on the outside in brickwork with stone and slate dressings; the floors are of reinforced concrete. Since the accommodation contemplated covered the provision of laboratories, two lecture theatres, an assembly hall, library, refectory with kitchen and administrative offices, there are available large open and well-lighted floor areas readily adaptable to office or other similar requirements.

Germany's Aluminium Industry

The *Engineer* is publishing a series of illustrated articles entitled "Air Force Targets in Germany", in which much information is given about the docks, harbours, canals, factories, railways and power stations which are so often in the news. Three of the latest articles to appear, published respectively on October 18 and 25 and November 1, deal generally with Germany's aluminium industry and especially with the large works at Lauta, to the north-west of Dresden, at Bitterfeld in the Leipzig district and at Rheinfelden in the extreme south-west of Germany. The last is the oldest works, having been started in 1898, while the other two were planned in 1915–17 to meet the needs of the time. Each of the works consist of three main sections; an electric generating and transforming station, factories housing the groups of electrolytic baths or furnaces and foundries in which the metal is cast into ingots and bars and rolled into sections and sheets. The raw materials needed for the production of one ton of aluminium are 4 tons of bauxite, 80 kilos of artificial cryolite, about 600 kilos of carbon electrodes, and some 23,000 kw. of electric energy. The process time varies from 100 to 130 hours. In 1929 Germany's output of aluminium was 33,000 metric tons out of a world total of 282,000 tons and by 1938 it had risen to 163,600 tons out of a world output of 579,900. More than 70 per cent of Germany's light alloy manufacturing capacity is Government owned, and every effort has been made to extend the use of these light alloys and to manufacture them from home-produced raw materials.

Telegraphic Typesetting

A paper on telegraphic typesetting by H. H. Harrison read and discussed before the Institution of Electrical Engineers appears in the *Journal* of the Institution of October. In the discussion, Mr. D. Murray pointed out that the paper is valuable because it reminds us that, in addition to strong stream and weak stream technique, there are controlling electro-mechanisms of the most remarkable character, correctly described as electrical typewriter-keyboard machines, of great complexity and beauty. The teletype, one of these keyboard machines, of which the fundamental characteristic is the transmission of intelligence by semi-mechanical machines (telegraph class of mechanisms), is in wide use in the form of a telegraph exchange, analogous to a telephone exchange, covering the whole of the territory of the United States, with about 15,000 subscribers. Considerable progress was being made in this direction in Great Britain also, and plans were being considered for spreading the exchange all over Europe. Unfortunately, this development has been interrupted by the War.

Mr. Harrison's paper deals with an astonishing extension of the telegraph-keyboard mechanism that combines the typewriter-keyboard mechanism with typesetting at a distance. Mr. Murray saw it in operation at the Western Electric Teletype factory in Chicago about three years ago. It was shown to him as an example of successful prophecy, because about forty years previously he had exhibited a typewriter telegraph of this class at the old Astor House in lower Broadway with the slogan "This tape sets type". He had brought the model from Australia and it attracted much attention. In his reply, Mr. Harrison said that Mr. Murray's forty-year-old prophecy was an interesting example of the slow growth of ideas. Although the Monotype keyboard producing a perforated tape and provided with an integrating counting mechanism was then available and was also as remotely situated from the type producer (the caster) as the present telegraphic typesetter keyboard, yet it is only comparatively recently that telegraphic typesetting has been accomplished.

Reducing Noise in Enclosed Spaces

During the last two years, progress has been made in the problem of noise reduction, especially in sound-proofing rooms against the transmission of external noise. In *Engineering* of October 25 the allied problem is described of sound-proofing rooms by using Accousti-Celotex tiles of sugar-cane fibre, manufactured by Messrs. Celotex, Ltd., Stonebridge Park, London, N.W.10. Under present-day conditions, many offices, etc., are more congested, with resultant increased noise. It is of interest, therefore, to cite certain data on sound absorption in offices which have recently become available. They are derived from tests made in the offices of an insurance company in the United States. This company has had about 300,000 square feet of Accousti-Celotex tiling fitted to its offices. Records were kept for a year preceding the fitting of the tiles and for a year after they had been installed. In two selected rooms, the increase of efficiency of the persons working therein was respectively 9·2 per cent and 7·7 per cent. Typists' errors were reduced by 29 per cent, and calculating machine operators' by 52 per cent.

It would appear that apparent loudness or annoyance increases much more rapidly at the higher loudness levels (in phons) than it does at the lower sound-levels, with the result that a relatively small reduction in phons at the higher levels decreases the apparent loudness very considerably. Thus it was found that a 7-phon reduction in a typing room with an average maximum loudness of 70 phons results in a decrease of 43 per cent in the apparent loudness or real annoyance, which condition is equivalent to the effect gained by the removal of about 80 per cent of the noise-making units. It is of interest to note that the tiles, from the material employed, are of light weight and are not affected as regards their sound-absorbing properties by painting. The grade of tile fitted in any particular case varies with the amount of noise normally present and the amount of absorption desired.

Mineral Resources of South Africa

The Executive Committee of the Third Empire Mining and Metallurgical Congress, which met in South Africa in 1930, prepared for the Congress a review of the mineral resources of the Union of South Africa. The success which attended the issue of this book led to its revision in 1936, and now, in 1940, the Department of Mines has published a third and again thoroughly revised edition. Introductory chapters deal with the geography and geology and with various historical and legal aspects of the mineral industry; but the bulk of the work, which extends to 544 pages, is devoted to individual economic minerals, of which the chief, in order of total output, are gold, diamonds, coal, copper ores, tin ores, asbestos, silver ores and the platinum metals.

Recent expansion of mining activity in the case of gold has led to results which indicate that former estimates of the future life of the goldfields were below the true figure. The opinion now expressed is that unless gold materially decreases in value, the future of gold mining in South Africa is secure for many decades to come. Diamond mining has recently been almost at a standstill, apart from the alluvial fields; existing reserves are sufficient to maintain normal production for nearly a century. Similarly, there are immense reserves of platinum in the Bushveld complex, and when prices become more favourable a great expansion of this branch of the industry is inevitable. Of coal and iron the Union possesses vast resources, coal being sufficient to provide for the needs of the country for many centuries. The book is copiously illustrated and well provided with maps and statistical tables, and will prove to be of great interest to a wide variety of readers.

Indian Association for the Cultivation of Science

The annual report for the year 1939 of the Indian Association for the Cultivation of Science includes as an appendix a report by Prof. K. S. Krishnan on the scientific work of the Association. This has included investigations on the magnetic properties of a free-electron gas with the view of determining the energy distribution, and Pauli's observation of a feeble paramagnetism independent of temperature in the electron gas has been verified for several metals. Landau's discovery of the appreciable diamagnetism of an electron gas has been experimentally verified, and recent measurements by Prof. Krishnan and Mr. N. Ganguli have shown that the conductivity of graphite in the basal plane is at least 10,000 times that along the normal to the plane. Other investigations have related to the mobile electrons in aromatic molecules, the diamagnetism of aromatic molecules, optical studies on aromatic molecules, magnetic studies on bismuth in the neighbourhood of its melting point, and paramagnetic studies on single crystals of the salts of the rare earth and the iron groups of metals, as well as structural studies on organic crystals, including the halogen derivatives of benzoquinone and related compounds. Notes on some spectroscopic work on the sulphides of the transitional group of elements and on the discovery of a new ionization layer in the upper atmosphere are also included.

Replenishing the Fauna of the Caspian

As a first measure to replenish the fauna of the Caspian—a problem on which the Soviet Ichthyological Research Institute has been working for some years—Nereis, the Polychæte worm relished by the sturgeon, bream and other fish, is to be brought to this land-locked sea from the Azov. The worm will be transported from the Azov Sea in isothermal boxes and put into the Caspian. Experiments carried out during the past three years have proved the possibility of transplanting certain species of invertebrates from the Azov to the Caspian. The Ichthyological Research Institute has decided to begin with the transplantation of Nereis, which is able to withstand changes in salinity and temperature and is unaffected by lower contents of oxygen.

Wilhelm Erb

Prof. Wilhelm Heinrich Erb, a pioneer in neuropathology and electrotherapy, was born at Winneweiler in the Palatinate on November 30, 1840. He received his medical education at Heidelberg, where he was assistant to Nikolaus Friedreich, and qualified in 1864. After working with Buhl at Munich on morbid anatomy, he was appointed extraordinary professor of special pathology and treatment at Leipzig in 1867 and full professor in 1880. Three years later he was transferred to the corresponding chair at Heidelberg, where he remained until his retirement in 1917. His first work was in connexion with toxicology, histology and therapeutics, but afterwards he devoted himself almost entirely to neurology. Erb's name, either alone or in association with those of other neurologists such as Duclenne, Charcot and Goldflam, has been given to several nervous diseases. He was also the first to describe the knee-jerk, independently of Westphal, and simultaneously with Fournier demonstrated the close etiological association between syphilis and tabes and general paralysis. He died on October 29, 1921.

The Night Sky in December

On December 22 the sun enters the sign Capricornus (the winter solstice). The night reckoned from sunset to sunrise then lasts 16¼ hours in the latitude of London. Full moon is on December 14 and new moon on December 28. At meridian passage soon after 0h. on December 15 at Greenwich, the moon's altitude is 57°. Jupiter and Saturn, the conspicuous pair of bright planets, are visible throughout the greater part of the night. On December 11, they are in conjunction with the moon at 1h. and 6h. respectively. (All times are given in Universal Time; add 1h. to convert into Summer Time.) Mars is a morning star rising about half an hour before Venus on December 15. These two planets are in conjunction with one another on December 2 at 12h. On December 25 at 18h., Mars is in conjunction with the moon, and Venus is likewise in conjunction on December 26 at 18h. The rapidly changing positions of Jupiter's four inner satellites, their transits and eclipses, may be followed from the data given on p. 630 of the *Nautical Almanac* or on p. 182 of *Whitaker's Almanack*. Saturn's unique ring system is well open; a refractor of 2 inches aperture or larger is, however, required to resolve the rings. The bright stars of Perseus, Auriga, Taurus and Orion (with Procyon and Sirius in train), bring glory to the December night skies. There are the open star clusters of Perseus, the Pleiades and the Hyades: many well-known double stars, variable stars and nebulæ in abundance. Near φ Tauri is a dark nebulous region which Barnard considered as giving the strongest proof of the existence of obscuring matter in space. Near the irregular variable star, *T* Tauri, is the remarkable object known as Hind's variable nebula. Two notable nebulæ, exemplifying two distinct types, are both visible to the naked eye on moonless nights during this month. These are the great nebulæ of Orion and Andromeda—the first a greatly extended diffuse nebula of radiating gas lying within our Milky Way system: the second, a vastly remote stellar system in itself, the prototype of many millions which are shown on long-exposure plates taken with the largest reflecting telescopes. At midnight on December 31–January 1, 1941, Sirius, the brightest star in the heavens, is within 2 minutes of the southern meridian of Greenwich.

Announcements

During a recent air raid, the Great Hall of the University of Bristol was damaged. The Great Hall is one of a series of magnificent buildings presented to the University by Sir George Wills and Mr. H. H. Wills, in memory of their father, the first Chancellor, and opened by King George V in 1925.

It is announced in *France*, the journal for Free Frenchmen published daily in Great Britain, that Prof. P. Langevin, who has just been awarded the Copley Medal of the Royal Society (see Nature, Nov. 23, p. 679) is now in prison.

Dr. G. Roussy, rector of the University of Paris and formerly dean of the medical faculty and professor of pathological anatomy, and M. Maurice Guyot, general secretary of the University, have been removed by order of the Vichy Government.

Dr. D. H. Peacock, professor of chemistry in the University of Rangoon and special chemical adviser (Customs) to the Government of Burma, is retiring from the service of the Government of Burma.

Dr. Dontcho Kostoff, of the Institute of Genetics, Academy of Sciences, U.S.S.R., has been appointed to a position in the Central Agricultural Experiment Station at Sofia, Bulgaria.

Mr. Harold Hartley has been appointed lecturer in mine surveying in the University of Leeds, in succession to Mr. T. Brown, resigned.

Mrs. J. R. Ogden and her family have presented to the Brotherton Library of the University of Leeds a large collection of lantern slides. These, added to the slides given by Mr. Ogden during his lifetime, bring the number in the Collection to more than five thousand. The slides deal largely with Palestine and Egypt, and include more than four hundred slides on the tomb of Tutankhamen.

It has been found necessary to close the Museum of the Royal College of Surgeons until further notice. Those who wish to present specimens to the Museum should retain them in their possession, but should notify the Curators of their intention to present them at a later date.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

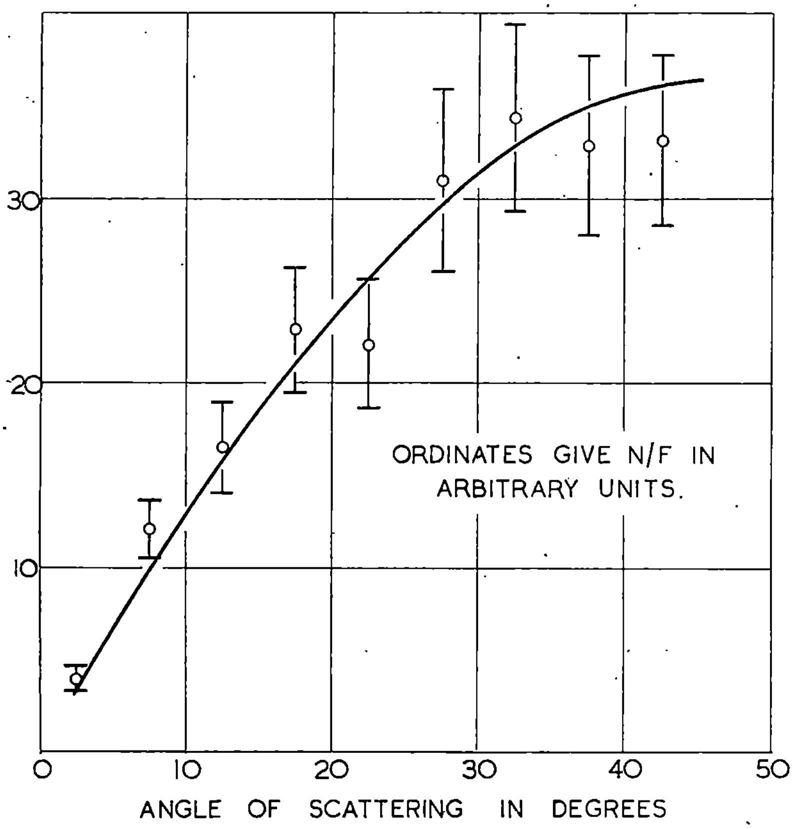
Neutron-Proton Scattering at High Energies

The angular distribution in the scattering of neutrons by protons has been investigated by a number of observers, particularly Dee and Gilbert[1], using neutrons with an energy of approximately 2·0 eMv. It is now generally agreed that the scattering is isotropic about the centre of the mass of the colliding particles with neutrons of this energy. We have recently investigated the scattering at much higher energies, using the 8·7 eMv. group of neutrons coming from boron under deuteron bombardment.

In a recent communication[2], one of us (C. F. P.) has shown that it is possible to measure the angle of dip of a proton track in a photographic emulsion relative to the plane of the emulsion, and hence to determine the spacial orientation of the proton track, with an accuracy of ± 1°. Attention was directed to the fact that this technical advance makes it possible to apply the photographic method to the determination of the spacial distribution of the protons arising from the photo-disintegration of deuterium by a directed beam of monochromatic γ-rays, and to the investigation of neutron-proton scattering at high energies. For the present experiments we passed the neutrons from a highly localized source, produced by bombarding a boron target by a 500 kv. deuteron beam 3 mm. in diameter, through a 'half-tone' emulsion 100 μ thick and in a direction parallel to the surface. Some of the neutrons make close collisions with the protons provided by the combined hydrogen in the emulsion and project them forward at various angles with the direction of the original neutron stream. We require to determine the distribution in angle of these protons relative to the direction of the neutron stream.

We first determined the range and orientation of all the distinguishable tracks of range greater than 15 cm. of air, present in 50 $mm.^2$ of the emulsion, which began and ended in the emulsion. 1,500 tracks were so measured, and of these, those tracks were chosen which had such a range and angle of scattering that their production could be definitely ascribed to the 8·7 eMv. neutron group. The method of deciding which energy group of the neutrons coming from the bombarded boron is responsible for a given track has already been described[2].

From these tracks only those were retained in which the inclination of the track to the plane of the emulsion, the angle of dip, β, was less than 10°. We were left with 400 tracks.



The number of tracks so chosen for which the angle of scattering lies between two given values evidently does not represent all the tracks in the measured area of the emulsion which have been scattered in this range of angles. Tracks will be neglected for two reasons :

(*a*) There is a rapidly increasing chance of failing to recognize tracks for which the angle of dip, β, is greater than 15°. The limitation β = ± 10° is therefore applied to avoid introducing uncontrolled errors.

(*b*) A certain fraction of the projected protons do not end in the emulsion but enter the glass of the plate or pass out of the surface of the emulsion. Such tracks cannot be definitely ascribed to a particular group of neutrons and are ignored.

We have thus defined the conditions in which a track is accepted. Of all the tracks produced by a neutron group of a certain energy and scattered within a given range of angles, a fraction *F* will be counted; *S*/*F* can easily be calculated, from the thickness and stopping power of the emulsion, for neutron groups of different energy. If *N* tracks are observed to be scattered in a given angular range by a group of neutrons of a particular energy, then the total actual number of such tracks in the emulsion will be given, within the limits of the statistical error, by the quantity N/F. From the observed distribution of number with angle, we can therefore calculate the distribution to be expected if all tracks were measured.

The results of our measurements are shown in the accompanying figure, in which the number, N/F, of tracks in successive intervals of 5° in the angle of scattering are shown as circles, the vertical straight lines through the circles indicating the extent of the probable error. The distribution calculated on the assumption that the scattering is isotropical about the centre of mass of the colliding particles is indicated by the continuous line. It will be seen that the experimental values are consistent with this assumption. We may therefore conclude that the scattering departs very little, if at all, from pure '*s*' scattering at 9 eMv.

It is evidently desirable to make similar investigations at higher energies, and our experience shows that this should be possible with the present methods at energies up to at least 15 eMv.

C. F. Powell.
H. Heitler.

Wills Physical Laboratory,
University of Bristol.

F. C. Champion.

King's College,
University of London.
Nov. 5.

---

[1] Dee, P. I., and Gilbert, C. W., *Proc. Roy. Soc.*, A, **163**, 265 (1937).

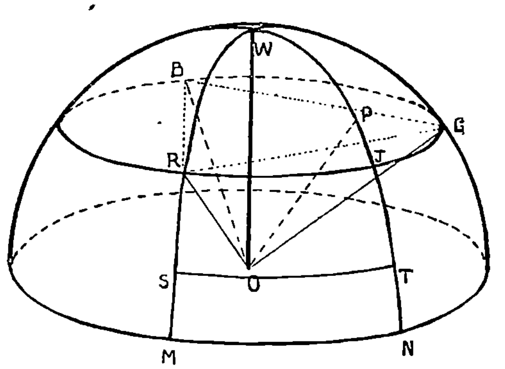
[2] Powell, C. F., Nature, **145**, 155 (1940).

Colour Vision and Chromaticity Scales

In a recent issue of Nature[1], Dr. W. D. Wright has given a very clear and interesting account of recent work in the direction of commercially practical application of measurement in the matching of colours, and in their analysis or synthesis. On the practical side the first steps were taken independently by Helmholtz and Maxwell in the employment of spectrum standards—always reproducible. By means of these, other standards, more normally attainable, more readily and simply usable by scientifically untrained workers, can be brought into employment.

The problem is simplified by the plan, first used by Maxwell, of keeping the intensity constant. Only two independent variables are then present, and so a pictorial representation of results can be made in two dimensions—in particular, on a plane. Dr. Wright discusses two such representations specially. As he points out, the great trouble in all these is that of getting a scale uniform in all stages of colour variation. Approximation to that state is all that can be attained.

My object here is to inquire if a different mode of procedure, first indicated by Helmholtz, might not be worthy of consideration. It consists in the use of the sensation space instead of the stimulus space. The accompanying diagram represents the construction, which employs a hemisphere with centre O. OW is a vertical radius, perpendicular to the circular base surrounding O. The distant viewpoint is in a direction inclined slightly above the base. The small circle RGB is parallel to the base, and OR, OG, OB are three mutually perpendicular lines, all equally inclined to OW, which may be taken as the usual axes of stimulus co-ordinates. The triangle RGB corresponds to the plane colour triangle of Maxwell, as used by him and Helmholtz. We can lay down on the plane of the triangle the spectrum curve in manner analogous to that used in the two diagrams dealt with by Dr. Wright.



Alternatively, we may consider Helmholtz's other representation by the sensation field. The line OW is the line of colourless (white) sensation. Any small (latitude) circle surrounding OW as polar axis is a curve of constant *whiteness* or constant *saturation*. Any longitude line is a locus of constant *hue*, more or less white. Constancy of the radius of the sphere corresponds to constancy of *intensity*, which is the third independent constituent quantity in luminous sensation. But the particular function of the radius which is used to express the intensity of a sensation has to be determined in accordance with Abney's law. This, and the fact that Fechner's law holds as a good first approximation, compel, as Pauli first pointed out, the adoption of the square roots of the stimuli as the component quantities to be measured along the axes OR, OG, OB. Thus the spectrum sensation curve can be drawn on the surface of the sphere.

The simplest law that we could postulate for the dependence of saturation changes and hue changes, in proceeding from one point to another on the sphere, is that of direct proportionality to the latitude and longitude changes involved. Thus increase of saturation would be taken to be proportional to increase of polar distance from W; and increase of a hue constituent would be proportional to increase of angular distance measured round OW. But the change of hue must also be proportional to the polar distance from W; for, when this is vanishingly small, rotation round W gives vanishingly small change from W, that is, vanishingly small change of hue. Thus the simplest expression for change of hue would be that of joint proportionality to longitude difference and latitude difference.

These are actually the laws, as Schroedinger first showed. A short deduction, by quaternionic treatment, has been given in Nature[2]. The first of the three terms in the last equation given on that page vanishes by the condition of constancy of intensity assumed here. (Towards the foot of the last column there, the first term on the right-hand side of the equation for Q' should read $2\,S \log q$.)

Let OP be the colour vector the difference of which from OR (standard red) is to be expressed. It is proportional to the great circle arc MN. So if we lay off SM or TN equal to PJ, the difference of hue sensation is proportional to the area of the spherical rectangle *MNTS*. With latitude and longitude arcs drawn sufficiently closely on the sphere to form a suitable scale, this gives a very easy estimate of the difference of hue ; similarly, in the case of any two colour vectors *OP*, *OP′*.

The outstanding difficulty, referred to by Dr. Wright, of getting a uniform chromaticity scale, remains. But it seems to me that the fact of the angular spread of the spectrum curve of sensation, amounting to 240° in the sensation space, as compared with 90°, or a little more, in the stimulus plane space, may indicate a considerable advantage.

In all adjustments taking place in the work of colour matching, it is equalization of sensation (hue or saturation) that is the direct aim. So this method of representation is very direct. Whether it be really superior to the representation used hitherto or not, I cannot judge, from want of familiarity with the practical needs. It would be of value to have Dr. Wright's view on the whole matter.

W. Peddie.

University College,
Dundee.

[1] Nature, 146, 155 (1940).

[2] Nature, 124, 791 (1929).

It would, as Prof. Peddie suggests, be possible to approach the problem of a uniform chromaticity scale from the point of view of the sensation rather than the stimulus. An investigation[1] somewhat along these lines is in fact in progress in connexion with the spacing of the colours on the Munsell system. But for ordinary colorimetric purposes, it is desirable that the distribution of colours should possess the geometrical relations characteristic of the trichromatic colour triangle, and to ensure that, the stimulus approach appears to be essential.

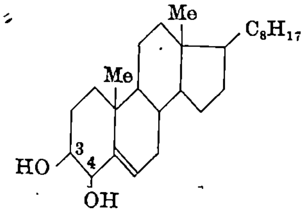
Further, I fear that the laws relating stimulus and sensation are so open to question, that a colour solid based on them would be unlikely to stand the strain of practical usage ; instead, the solid would have to be derived from fresh experimental observations of colour differences, as in the case of the Munsell system. It might happen that identical colour distributions would be obtained whether the stimulus or the sensation approach were employed, but I can see no theoretical reason why this should occur, nor, so far as I know, is there any experimental evidence suggesting such a fortunate contingency.

W. D. Wright.

[1] Newhall, S. M., *Amer. J. Psych.*, 52, 394 (1939).

Formation of Insoluble Digitonides of Cholesterol Derivatives

In the course of an investigation of 6-chloro-3-benzoyloxy-Δ^4-cholestene[1], we have isolated a monobenzoate (m.p. 153–154°) of *cis*-3 : 4-dihydroxy-Δ^5-cholestene (I) which differs considerably from the monobenzoate (m.p. 209–210°) of the *cis*-diol prepared by the method of Rosenheim and Starling[2] ; the latter has been accorded the 3-monobenzoate structure on the seemingly substantial evidence that the *cis*-diol (I) gives an insoluble digitonide, whereas the monobenzoate, m.p. 209–210°, fails to do so. To test the implication that the new ester, m.p. 153–154°, is the 4-monobenzoate, its reaction with digitonin was examined. It fails to give a digitonide using standardized conditions which effect immediate precipitation of the digitonides of cholesterol and the *cis*-diol (I). It follows that the formation of one of the monobenzoates of the *cis*-diol has been accompanied by the migration of a benzoyl-group from the C_3- to the C_4-hydroxyl, and although such migration appears to be less likely in the case of the monobenzoate m.p. 209–210°, the exact location of the esterified hydroxyl group in the mono-esters[3] remains to be rigidly established. Furthermore, it is clear that the introduction of a C_4-*cis*-benzoyloxy-group into cholesterol prohibits the digitonin reaction.



(I)

F. S. Spring.
G. Swain.

The University
Manchester.
Nov. 1.

[1] Spring, F. S., and Swain, G., *J. Chem. Soc.*, 1356 (1939).

[2] *J. Chem. Soc.*, 377 (1937).

[3] (Added in proof). Dr. O. Rosenheim informs us (private communication) that he has prepared the hitherto unknown 4(?)-monoacetate of the *cis*-diol which, as we find is the case with the 3(?)-monoacetate, fails to give an insoluble digitonide.

A Non-Historical Eclipse

In John Evelyn's "Diary", under the date October 14, 1688, there is a record of an eclipse of the sun. Now it is quite true that an eclipse took place, but this was not visible in any part of Europe. The central line passed very far south, and even the limit of the partial phase came only a few degrees north of the equator near its farthest extension to the north and west.

The reference to the eclipse consists of a sentence of only six words, which has much of the appearance of being a subsequent insertion. That is probably what it is, as the diarist can only be stating what some other person told him, and thus there is reason for concluding that some traveller from rather distant regions supplied the information at a later date. It is difficult to think of an answer to the problem of who the observer can have been.

The rest of the entry in the Diary states that the day was a Sunday, and prayers were offered in the churches for protection from invasion. This naturally attracts attention, but the reference is merely to Prince William of Orange, for whose arrival many Englishmen "were passionately longing".

These are Evelyn's own words, and the use of the past tense is further evidence of the fact that he was making insertions at a later date. On the third Sunday after that, the Prince, favoured by a "protestant wind", sailed into a British seaport ; and he found the men of Devon willing to give him plentiful assistance in landing.

C. J. Westland.

Christchurch,
New Zealand.
Sept. 1.

RESEARCH ITEMS

Early Chinese Lacquer Toilet-Boxes

Two pieces of outstanding importance from the last of the Eumorfopoulos collection have been presented to the British Museum; one, a Chinese lacquer toilet-box, purchased by the National Art-Collections Fund, and the second, the blue splashed T'ang pottery horse which was the late owner's special favourite, presented by Mrs. G. Eumorfopoulos in memory of her husband (*Brit. Mus. Quarterly*, 14, 3; 1940). In a description of the two pieces by B. Gray, the lacquer box is stated to be much the most important piece of Early Chinese lacquer to have left the East. It is remarkable for its fine state of preservation and for unique features of its decoration. Judging from finds made by Japanese archæologists in Korea, painted lacquer was the most usual material for articles of luxury in the Han period, after Chinese taste had changed about 600 B.C. from an interest in plastic form to a preference for enrichment of surfaces. In the 'Hwai-style period' inlay was extensively used to enrich the bronzes; but in the Han period a freer technique of painting came into fashion. Though also tomb furnishings, the lacquer boxes, tables and utensils must certainly have been used by the owners before death. In the tombs of Lo-lang of South Korea, of the considerable number of lacquer objects found, the most important are the toilet-boxes. These are of three main shapes, small oblong, high rectangular with coffered lids, and circular boxes with domed lids. Although several are inscribed as having been made in Szechwan, until lately no piece was known to have been found on Chinese soil. The present example, however, is said to have been found in a tomb at Haichow in the northern part of Kiangsu near the old bed of the Yellow River. It resembles generally the round toilet-boxes found at Lo-lang, but has important differences, and it differs in the style of the painted decoration. In consequence it has been assigned to the third century B.C. This is before the period to which the Korean boxes all appear to belong in the first century A.D. Probably the true date is somewhere between the two.

Parasites of the Oriental Fruit Moth

CIRCULAR 561 (June 1940) of the United States Department of Agriculture is devoted to an account of the importation, rearing and colonization of various parasites of the oriental fruit moth (*Grapholitha molesta*). The authors, H. W. Allen, J. K. Holloway and G. J. Haeussler are officers of the U.S. Bureau of Entomology and Plant Quarantine. Since about 1923, when this moth became a formidable pest in the eastern States, a good deal of consideration has been given to its control by means of parasites. The reason for this emphasis has been the absence of generally accepted artificial means of control and the great reduction in the insect's destructiveness in some areas where heavy parasitization by indigenous parasites prevails. Much of the parasite work is centred in a special laboratory at Moorestown, N.J., where extensive rearing of imported parasites has been carried out. Of these latter, seven are European species, two Australian and seventeen from China and Japan. One of the most important phases of the work has been the multiplication of the indigenous parasite *Macrocentrus ancylivorous* and its colonization throughout the area infested by the moth. The breeding for colonization of six of the principal imported species was also a major aspect of the work. It is noteworthy that no satisfactory results have been obtained by the propagation and liberation of the indigenous egg-parasite, *Trichogramma minututum*. It has not yet been possible to make recovery tests from a large proportion of the parasites liberated in different areas affected by the moth. From such recoveries that have so far been made the indications are promising, and several species have multiplied rapidly immediately following their release.

Heterosis

I. N. SVESCHNIKOVA (*J. Hered.*, **31**, 349–360; 1940) has analysed the chromosome constitution, vigour and other characters in hybrids between species and varieties of Vicia. It is believed that there is a relation between the length of the chromosomes *A*, *F* and *E* and the growth of definite quantitative characters. This relationship can be explained by the existence of additional genes due to duplication of parts of the chromosomes. There is a gradual change in the homologous chromosomes in the closely related species *V. amphicarpa*, *sativa*, and *angustifolia*. Thus the *A* and *F* chromosomes progressively increase in length from *N. amphicarpa* to *V. angustifolia doliochosomica*, while basal branching of 2-3 branches in *amphicarpa* increases to 20 in the last variety, and the bending-back of the standard and wings similarly increases in degree in the species. Hybrids between a race of *V. angustifolia brachisomica* and *V. a. doliochosomica* show 150 per cent increase in height over the parents. On the other hand a different race of *V. a. brachisomica* in a similar cross gave dwarf, stunted plants. Other species-crosses support the view that genes for growth are combined in the species hybrids and that plus-heterosis or minus-heterosis (depressed vigour) may be produced. Sveschnikova also notes that dominance as well as heterosis is more pronounced in species with the longer chromosomes. Segregation in second generation hybrids gives results expected on this hypothesis.

Earthquakes during October

DURING October last, five distant earthquakes were registered at Kew Observatory. The first, on October 1, had an amplitude of 25 μ at Kew, and the second, on October 4, probably the largest in the month, gave a ground amplitude of 110 μ at Kew, being estimated at an epicentral distance of 10,260 km. The third, on October 11, probably 12,300 km. distant, gave a ground amplitude of 78 μ at Kew, whilst the fourth, on October 22, may have originated 2,040 km. away. On October 27, an earthquake, probably at an epicentral distance of 8,720 km. from Kew, commenced registration with a compressional wave at 5h. 47m. 39s. at Kew, and at its maximum attained an amplitude of 39 μ there. This latter record, however, was disturbed by irregular long-period waves which had been noticeable throughout the day. A further earthquake was recorded by the Bombay Observatory on October 5 and was thought to have had its origin in Tibet. Early on October 11, the region around Los Angeles and Hollywood was shaken by a tremor felt for 10 seconds, though no damage was reported. The Rumanian earthquake of October 22 has been reported previously. Late on the night of October 26 an earthquake rocked the Republic of Costa Rica in Central America, causing some apprehension, though again no damage has been reported.

Earthquakes Registered in Switzerland

During July 1940, nineteen earthquakes were registered at the Swiss observatories of Basle, Chur, Neuchâtel and Zurich. The shock of July 1 was in the Azores and that of July 6 in the West Indies. The deep-focus shock of July 10 (*ca.* 550 km.) was in the region of Tibet, and that of July 14 in the Aleutian Islands. The earthquakes of July 26, 27 and 31 were respectively in the Jura, Central America and Anatolia. During August, sixteen earthquakes were recorded. On August 4 the epicentre was near Simplon and on August 6 in the Swabian Alps near by. The shocks of August 16 and 22 were in Asia Minor and the Aleutian Archipelago respectively, all the epicentres being determined at Zurich.

Seismological Observations at St. Louis

Between June 5 and August 1, 1940, twenty-three earthquakes were registered on seismographs throughout the United States of America belonging to the Jesuit Seismological Association. At the central station at St. Louis, J. B. Macelwane, *S.J.*, and his colleagues evaluated the initial time, epicentre and depth of focus of the twelve most intense of these from all the records available to them. Besides their own, these included records from stations belonging to the United States Coast and Geodetic Survey and private observatories. The shock of June 5, on a basis of twenty-one records, had its epicentre in north-west Canada, and that of June 17 originated in the Pacific Ocean north-east of Hawaii. The second shock of June 23 originated in the Gulf of California. On July 6 there was an earthquake near the Windward Islands, while the shocks of July 10, 13 and 14 were centred in Manchuria, near Panama, and in the Aleutian Islands respectively. The earthquakes of July 19, 20, 27 and 30 had epicentres in the Aleutian Islands, near Samoa, near Guatemala, and in Anatolia respectively, and the shock of August 1 had its epicentre in the Sea of Japan between the Japanese islands and the mainland. The deepest focus shock was that of July 10, near 550 km., and other deeper than normal shocks were on July 6 (160 km.), July 14 (80 km.), and July 27 (100 km.). All the determinations are said to be tentative.

Ionization of the Lower Atmosphere

In the *Proceedings of the Royal Irish Academy* (46, Section A, No. 7; 1940) J. J. Nolan adds another paper to his many contributions to the study of the ionization of the lower atmosphere. It is pointed out that concentrations of small ions in the atmosphere of the order of 2,000–2,500 per c.c., obtained from the equation for equilibrium of ionization in a pure gas, that is, $dn/dt = q - \alpha n^2$ where n is the concentration of small ions of one sign (positive and negative being assumed to be equal), q is the rate of production of ion pairs per c.c. and α is the coefficient of recombination between positive and negative small ions, are very rarely met with in the atmosphere, while in cities n can fall below 100 owing to the attachment of ions to Aitken nuclei. The author goes further into the subject, discussing relevant observations, made in various parts of the world, including Australia and Java, and suggests that the equilibrium of small ions at any place in the lower atmosphere is represented by the equation $q = an + bnZ$, where n and Z are the concentrations of ions and nuclei; a being apparently constant under normal conditions, while b depends upon the nature of the nuclei present.

Solubility of Lead Salts

The solubility of lead sulphate in ammonium acetate solution is a well-known reaction in analytical chemistry. It has been attributed to the formation of undissociated lead acetate (Noyes and Whitcomb, *J. Amer. Chem. Soc.*, 27, 747; 1905) and to the formation of an acetoplumbite complex ion (White, *Amer. Chem. J.*, 31, 4; 1904). Sanved (*J. Chem. Soc.*, 2967; 1927), from the increased solubility of lead acetate and other lead salts in alkali acetate solution, concluded that the ion formed is probably $Pb(C_2H_3O_2)^+$, a result of the primary dissociation of lead acetate; but the experimental results were obtained with high and varying salt concentration, where the application of the law of mass action could only be qualitative. S. M. Edmonds and N. Birnbaum (*J. Amer. Chem. Soc.*, 62, 2367; 1940) have determined the solubility of lead iodate at constant ionic strength in presence of varying acetate ion concentrations. The results are interpreted in terms of a complex ion $Pb(C_2H_3O_2)_n{}^{+2-n}$ and the slope of the curve shows that $n = 1$. Hence the complex ion is $Pb(C_2H_3O_2)^+$ and it may be inferred that the same product is formed from lead sulphate. Of the two alternative explanations, the formation of a complex ion seems, therefore, more probable than the production of undissociated lead acetate.

Trimethylcarbinol as a Cryoscopic Solvent

As a cryoscopic medium of moderate solvent power and having a melting point not far removed from room temperature trimethylcarbinol seemed to have the desired properties. The cryoscopic constants of this substance are, however, very discrepant. In a new investigation by F. H. Getman (*J. Amer. Chem. Soc.*, 62, 2179; 1940) it is shown that by a suitable experimental procedure a sample of trimethylcarbinol having a steady melting point can be obtained; the freshly distilled solvent is removed to a room at a temperature considerably lower than its freezing point 25·1°, thus preserving it in the solid state except when required for use. The melting point then altered only slightly with time. A series of thirty solutes was used and the freezing point concentration curves were drawn. The slope of each curve at the origin gave the cryoscopic constant K. Apart from cases where interaction between solvent and solute occurred the mean value of K was 8·37, whereas the value calculated from one of the discrepant heats of fusion (21·88 cal./gm.) is 8·15. The use of trimethylcarbinol is thus shown to be entirely satisfactory as a cryoscopic solvent, provided due care is used in its preparation and preservation, and it is particularly useful when a melting point not far removed from room temperature is desired.

FERTILITY IN FLEMISH AND SMALLER TYPES OF RABBIT

By W. King Wilson,

Harper Adams Agricultural College

THE Flemish Giant is the largest breed of rabbit, and at first sight it would appear to be the most important breed for meat production. In practice, however, there is a relative scarcity of breeders who persevere with studs of typical Flemish. (It is essential to distinguish between typical Flemish, as described in the standard, and the many crosses which are often loosely described as 'Flemish'. The reasons appear later.) The standard for the Flemish Giant[1] specifies a large animal of steel-grey colour with white belly fur. No other colour is recognized in Great Britain; but in other countries a wider range is admitted. For show purposes the standard weights of adults are: bucks 11 lb. or more, and does 12 lb. or more; in 'intermediate classes' they must be less than the above weights. Whilst allowing for difficulties in securing great size and weight, together with all the other points required in show stock, the fact that there are not more breeders of a rabbit of this size suggests that there must be some underlying drawbacks.

Flemish Giants represent remarkable development and size improvement over the wild ancestor, amounting to some 300–500 per cent increase in weight over the original stock. It has been pointed out that the higher the level of production the greater the strain in maintaining that level[2], and finer adjustments are needed at the higher plane of nutrition. Furthermore, large breeds tend to have more young to the litter than small breeds[3,4]. Great size and weight though heritable are unfortunately not due to a single dominant factor, but are due to multiple factors[5,6,7,8]. This large size is of national importance for meat production in war-time. The fur colour of Steel Flemish[9] was not found to be so difficult to produce as earlier investigators had indicated from work with other varieties of steel rabbits[10,11,12,13,14]. The pelt is practically as large as that of the silver fox animal.

One of the difficulties of producing typical Flemish Giants is that they often tend to be slothful and difficult to mate when kept on the usual mixed ration. Close inbreeding for five generations was reported to have resulted in complete sterility[6]; but similar results also occurred with an inbred small breed. Hammond has published the histories of sterile Flemish bucks and does and has fully described their histological condition[15]. Some individuals are particularly troublesome, but may sometimes be assisted by appropriate handling. This disinclination to copulate, and the number of infertile matings, is very marked by comparison with the smaller and intermediate breeds. Both the latter are much more popular with breeders.

During last winter the severe frosts prevented the use of green foods for approximately two months (January and February) and roots were generally too frosty for use. Over a period of eight weeks the stock received an average of only one feed of roots or beet pulp weekly. It should therefore be interesting to compare the fertility of Flemish and smaller breeds during this and the immediately ensuing breeding season.

EXPERIMENTAL

The stock was divided into three main groups comprising (*a*) Flemish and first cross Flemish does; (*b*) brown Beveren type does; and (*c*) Dutch does. There were thirty-two to thirty-four matings, or attempted matings—by putting the doe to the buck—in each group. Fertility of does in the different breeds is shown below:

TABLE 1. FERTILITY OF FLEMISH AND SMALLER TYPES.

Breed	Flemish	Flemish first cross	Combined	Beveren type	Dutch	Total
No. matings attempted	21	13	34	34	32	100
No. litters	9	12	21	31	28	80
Per cent fertile	42·86	92·31	61·76	91·18	87·50	80·00

The fertility was good in Beverens (91 per cent) and Dutch (88 per cent), the latter's average being reduced by one doe which required 3 matings to become fertile. The well-bred typical Flemish stock gave a very poor level of fertility (43 per cent); but in striking contrast to this the first cross Flemish does were practically always fertile, with 12 litters from 13 matings, or 92 per cent. The F_1 does consisted of seven matings from large × large type (Flemish × Belgian) does, which produced six litters; and six matings of large × small type (Flemish × Tan) does which produced six litters. Thus it appears that the type to which the Flemish is crossed is immaterial, and regardless of the size of breed used for the outcross the F_1 show remarkable improvement in fertility over typical Flemish stock.

The average litter size from these different groups did not provide any large differences in the number of young:

TABLE 2. LITTER SIZE FROM FLEMISH AND SMALLER TYPES.

Group	Flemish	Flemish first cross	Combined	Beveren type	Dutch
No. of litters ..	9	12	21	31	28
Average number of young ..	5·22	5·08	5·14	5·19	5·43
Range	2–11	1–8	1–11	2–8	1–9

The litter size for Flemish was lower than usual, although the largest litter (eleven) was produced by this breed. The average for F_1 does was also lower than expected; the Flemish × Belgian was only 4·50, whilst the Flemish × Tan was 5·67 per litter. The Flemish had the greatest range of litter size, and the Beveren had the narrowest, as shown in

Table 3. The Dutch maintained a good average, for their size, at 5·43 per litter, which is explained by nineteen of these litters being from outcrosses averaging 5·58, whilst the average from Dutch × Dutch matings was 5·11. The range for Dutch × Dutch litters was 4–7 but was more than doubled when outcrossed, ranging from 1–9 young, which, surprisingly, is greater than from the larger type does from the Flemish outcrosses.

TABLE 3. DISTRIBUTION OF LITTER SIZE BY BREED.

Litter size	Flemish	Flemish first cross	Combined	Beveren type	Dutch	Total
1	–	1	1	–	1	2
2	1	2	3	2	1	6
3	2	1	3	3	–	6
4	–	–	–	5	7	12
5	4	2	6	5	5	16
6	–	2	2	6	6	14
7	–	1	1	8	5	14
8	1	3	4	2	2	8
9	–	–	–	–	1	1
10	–	–	–	–	–	–
11	1	–	1	–	–	1
Total	9	12	21	31	28	80

A guide to the weight of different groups of does is taken from their live weights during lactation at approximately the time when the young began to leave the nest: Flemish, 9 lb. 6 oz.; Flemish and first cross, 8 lb. 13·13 oz. (Flemish × Belgian, 8 lb. 11·67 oz., and Flemish × Tan, 7 lb. 3·00 oz.); Beveren, 7 lb. 0·47 oz.; Dutch, 4 lb. 14·00 oz. It will be seen that popular varieties of fur and fancy breeds bred more freely than giants. Furthermore, after weaning, the small types were ready for further breeding sooner, and more readily, than large heavy animals.

CONCLUSION

The Flemish Giant is the largest breed of rabbit, but it is slothful and more difficult to breed than either the medium-sized fur breeds or the small fancy breeds (for example, Beverens and Dutch), when fed and managed under similar conditions.

First crosses from Flemish were fertile, irrespective of whether the cross was to large or to small breeds.

After an abnormally severe winter, which resulted in changes of diet, the average litter size of larger types was lower than expected and nearer the level for small breeds.

[1] Standard. Flemish Giant Rabbit Club, London.

[2] Wilson, W. King, and McCartney, W., "Rabbit Feeding for Meat and Fur", Imperial Bureau of Animal Nutrition, Aberdeen, Technical Communication No. 12 (1940).

[3] Pickard, J. N., "A Preliminary Study of Some of the Factors Influencing the Duration of Pregnancy and Litter Size in the Rabbit," IVth World's Poultry Congr. Papers, Section F, 901 (1931).

[4] Rosahn, P. D., Greene, H. S. N., and Hu, C. K., *Proc. Soc. Exp. Biol. and Med.*, 31, 1214 (1934).

[5] Punnett, R. C., and Bailey, P. G., *J. Genet.*, 8, 1 (1918).

[6] Pease, M. S., *J. Genet.*, 20, 261 (1928).

[7] Castle, W. E., "Size Inheritance in Rabbit Crosses", Carnegie Inst., Washington, Pub. No. 320, 3 (1922).

[8] Wilson, W. King, *J. Heredity*, 27, 127 (1936).

[9] Wilson, W. King, "Alternative Modes of Inheritance of Steel Grey Coat Colour in Rabbits", VIIth Internat. Genet. Congr., Section D, 1939.

[10] Punnett, R. C., *J. Genet.*, 2, 221 (1912).

[11] Punnett, R. C., *J. Genet.*, 5, 37 (1915).

[12] Punnett, R. C., *J. Genet.*, 23, 265 (1930).

[13] Pap, E., *Z. Induktiv. Abstammungs- und Verebungs-lehre*, 26, 185 (see 14) (1921).

[14] Onslow, H., *J. Genet.*, 12, 91 (1922).

[15] Hammond, J., "Reproduction in the Rabbit" (Edinburgh: Oliver and Boyd, 1925).

BICENTENARY OF HENRY CORT

OF the leading contributors to the advancement of British industries in the latter half of the eighteenth century, Henry Cort is the one of whom we know least. It is generally stated that he was born near Lancaster in 1740, and to mark his bicentenary, at a meeting of the Newcomen Society on November 13, Dr. H. W. Dickinson read a paper giving much new information about the inventor and his activities. Though nothing is known of Cort's education and early life, by 1765 he had established himself in London as a Navy agent, having an address in Crutched Friars in the east of the City, in which also was a Navy pay office. The district was one familiar to Pepys and has many associations with the Navy of bygone days. A Navy agent was a banker and attorney who acted for H.M. ships as to pay, allowances, prize money, salvage and such like; and it was Cort's connexion with the Navy which ultimately led to his becoming an iron master.

From 1765 Cort slowly emerges from the obscurity of his early life. In 1768 he married a niece of a Mr. Attwick who had contracted to supply mooring chains and other iron naval stores to Portsmouth Dockyard, but who in 1772 assigned his contract to a Mr. Morgan, who had a forge at Fontley, in the parish of Titchfield, two miles from Fareham at the north-west corner of Portsmouth Harbour. Britain at this time was largely dependent on Sweden for its wrought iron, and Morgan's work consisted more in remaking old wrought iron into new articles than in the production of the iron itself. From the beginning of the eighteenth century a forge had been in existence at Fontley, where there was a tilt hammer worked by water-power and an adequate supply of charcoal. Morgan being in financial difficulties, Cort came to his assistance, and in 1775 took over the management of the concern. Under Cort, the works were improved and the profits considerable. In spite of this there was further need for capital, and Cort accordingly secured the help of Adam Jellicoe who, while pay clerk at Portsmouth, had acted as his agent.

By 1781–83 the works were engaged on the conversion of considerable quantities of old iron mast-hoops into new hoops, and it was then that Cort made a variety of experiments and took out the first of his two memorable patents. The date of this patent, No. 1351, was January 17, 1783. It was for "A New Mode and Art of Shingling, Welding and Manufacturing Iron and Steel into Bars, Plates, Rods and otherwise, of Pure Quality, in large Quantities by a more effectual Application of Fire and Machinery, and with greater Yield, than any Method before attained or put in practice." "In the specification Cort further described passing the heated iron through the rollers of a common rolling mill and the making of bars, bolts, half flats, etc., by the use of rollers with grooves and collars."

Thirteen months later Cort secured his other patent, No. 1420, of February 13, 1784, for "A Peculiar Method and Process of Preparing, Welding, and Working various Sorts of Iron, and of reducing the Same into Uses by Machinery," in which he described the process afterwards known as "dry puddling", a process which, using coal instead of charcoal, was destined to be of immense importance to the iron industry. In examining Cort's practices and patents, Dr. Dickinson came to the conclusion that there could be no doubt that the patents are simply a recapitulation of the technique Cort was carrying out at Fontley. Cort, of course, was not alone in his endeavours to improve the production and working of iron, but after reviewing the efforts of his contemporaries Dr. Dickinson concluded that "what we can say of Cort was that he gathered existing knowledge and technique, absorbing what was useful and necessary for his purpose, rejecting what was not needed, and combining it into a system which, as a whole, constituted such an advance that it marked an entirely new era in the manufacture of wrought iron. The effect of his labours was immediate; whereas a tilt hammer had been able to produce a ton of bars in 12 hours, no less than 15 tons could be passed through the rolls in the same time; the iron, produced as it was entirely by pit coal, was of a quality that enabled it to compete for all but the most exacting requirements with the charcoal iron of Sweden, Russia and New England. The process enabled Great Britain, relying on mineral fuel, to advance within a decade to the premier iron-producing country of the world."

Contracts from the Navy Board continued to come to Cort and Jellicoe, and Cort travelled to many places to assist iron makers to instal his rolls and puddling furnaces. If all had gone right he should have gained a fortune comparable to that later enjoyed by Bessemer. It has been the lot of many inventors to see the financial rewards due to them slip through their fingers, but none of them, perhaps, was treated more unkindly by fate than Cort. Five years after his patent of 1784, which afterwards led to the construction of puddling furnaces by the thousand, Adam Jellicoe died and his papers showed that he was in default to the Navy for no less than £39,676. There being then no limited liability, the works were seized, no effort was made to exploit the patents, and Cort was reduced to bankruptcy. With a numerous family Cort was left to struggle along as best he could, save that in 1791 he was granted a Government pension of £200 a year, which with reductions for fees amounted to little more than £160. Nine years later, on May 23, 1800, he died and was buried in Hampstead Churchyard, his death passing with no notice save a couple of lines in the *Gentleman's Magazine*.

Such is briefly the outline of the story Dr. Dickinson had to tell. Many famous men were interested in Cort's work, including Black, James Hutton and Watt, and the latter wrote of Cort as he knew him at the age of forty-four that "he seems a simple good-natured man, but not very knowing." Though neglected in his day, Cort has not wanted for admirers in our own times, and it was through an American ironmaster, Charles H. Morgan (1831–1911), that Cort's tombstone in Hampstead Churchyard was renovated and a bronze tablet placed in the porch of the church saying that to Cort "the world is indebted for the arts of refining iron by puddling with mineral coal and of rolling metals in grooved rolls". Introduced in a period when the steam engine was making rapid strides, when men were experimenting with iron boats, steam-boats, locomotives, and iron railroads, and when iron was being widely used as a material for construction, Cort's improvements enabled our ironmasters to meet all the rapidly growing needs of the pioneers of the modern engineering world, and his methods were not superseded until the labours of Bessemer, Siemens, Martin and others ushered in the age of steel.

SOIL BACTERIA AND WAR WOUNDS

By Dr. Hugh Nicol

A SURGICAL development which evolved on a large scale in the recent Spanish Civil War is the treatment of dirty and often comminuted and complicated fractures by immobilization in a plaster cast. The cast is applied immediately after the wound has been made 'mechanically' clean by removal of bone and metal splinters and fragments of clothing and other foreign matter and by resection of all dead tissue that can be found; no antiseptic is applied to the wound itself. Subject to this preliminary cleansing and to the provision of traction and drainage as necessary, no other treatment is given during the month or so during which the first cast is in position; the plaster is then changed, and the second cast is allowed to remain for some weeks, after which union and healing are usually remarkably complete.

The success of the treatment depends on ignoring the bacterial processes such as surgeons normally take great pains to combat by the use of antiseptics, irrigation, and frequent changes of dressings: it has been found that, given the initial surgical *débridemen* and cleansing, and complete immobilization, no general infection occurs. There is locally great microbiological activity, as is evidenced by the stench given off during the first three weeks (this is apparently the only objectionable feature of the treatment), but undesirable complications of bacterial origin—such as gas gangrene—are rare. The treatment is largely empirical; its justification is that it has worked. A history of the treatment and an analysis of its application to a large number of cases have been given by J. Trueta[1], sometime director of the Department of Surgery in the General Hospital of Catalunya, Barcelona.

It could scarcely be expected that in the stress of civil war the microbiological changes could be examined in detail. It has been shown (*loc. cit.*) that the organisms in a plaster-treated wound are mainly aerobic, but no particular species or group of aerobes predominated, except that there was a tendency for

B. pyocyaneus to become more numerous when the healing process was well established.

However obscure the theory of the treatment is, the references to soil bacteriology made in connexion with it require attention. Trueta records (p. 17): "The incidence of gas gangrene and of other infections fell so markedly [after a thoroughgoing adoption of the treatment] that it has been suggested that the soil of Spain contains no anaerobes. These suggestions emanate from foreign surgeons who came to Catalonia in the later stages of the war: at the beginning it was demonstrated grimly enough that the soil of Spain is not free from these organisms." This notion is not confined to Spanish territory. The commandant of an English ambulance who is known to me attended in London a course of lectures given by a British medical man, who averred that the treatment could not be expected to be successful in all countries: in Spain, where such sub-tropical crops as grapes and oranges grow in the open air, the soil micro-organisms were necessarily different from those occurring in more temperate climates.

Though no determination of Spanish soil microflora is at hand, there is no evidence that the broad types of soil micro-organisms vary with climate. A high degree of constancy of species has been demonstrated for soil Protozoa in samples taken in the most diverse parts of the world[2], while to mention only three sets of determinations of species of soil bacteria, the work of Chr. Barthel[3] on Greenland soils, and various papers by M. Adachi [Adati] on Formosan microflora, have revealed scarcely any but familiar species; a similar remark applies to the bacteriological findings from the second Byrd Expedition to the Antarctic. Barthel also showed that the dung of polar mammals contained bacteria similar to those occurring in the dung of common animals of temperate regions.

The main groups of soil bacteria are probably ubiquitous, and the medical men concerned should call upon their soil scientist colleagues before erecting theories about the distribution of soil micro-organisms. One is left with an uneasy feeling that the fact of the existence of anaerobes in Spanish soil has been established by the clumsy method of observation of human patients. The point is not important, but co-operation between soil bacteriologists and the medical profession would have obviated a mis-statement.

The success of the treatment seems to repose less upon the distribution of bacterial species than upon a factor or set of factors to which the medical profession in its preoccupation with pathogenicity of bacteria has given little attention: namely, the powers of resistance of living tissue towards microbial invasion. R. Giani[4] showed that inoculation with anthrax bacilli of open wounds of experimental animals was harmless if the affected limb was immobilized. This is significant, and if the true implications of the plaster-cast treatment of war wounds are followed up, the present importance of using antiseptics and of other treatments aimed at annihilating bacteria will almost certainly give way to a recognition of the importance of constructive methods of building up bodily resistance to adventitious infections.

FORTHCOMING EVENTS

Monday, December 2

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 3).

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. J. V. Harrison: "Coastal Makran".

Tuesday, December 3

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. J. D. Bernal, F.R.S.: "The Physics of Air Raids".

Wednesday, December 4

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. D. E. E. Gibson: "Problems of Building Reconstruction".

Thursday, December 5

Royal College of Surgeons of England (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 2.30 p.m.—Mr. T. P. McMurray: "The Semilunar Cartilages" (Robert Jones Memorial Lecture).

Friday, December 6

Association of Applied Biologists (in the Congregational Hall, Victoria Road, Harpenden), at 12 noon.—Sir E. John Russell, F.R.S.: "The Function of Applied Biology in War Time".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

General Secretary—The Hon. Secretary, International Federation of University Women, 38 St. Leonard's Terrace, London, S.W.3 (December 4).

Headmaster of the Maidenhead County Boys' School—The Education Secretary and Secretary to the Governors, Shire Hall, Reading (December 5).

Keeper of the Yorkshire Museum—The Honorary Secretary, Yorkshire Philosophical Society, The Yorkshire Museum, York (December 7).

Teacher to take charge of Electrical Engineering—The Principal, Technical College, Wolverton, Bucks (December 9).

Assistant Officer (Civil Engineer) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (quoting Appointment 1/10A) (December 14).

Master of Method and Lecturer in Geography (male) at the Edinburgh Training Centre—The Executive Officer, 140 Princes Street, Edinburgh 2 (December 14).

Warden of Ashburne Hall of Residence—The Registrar, The University, Manchester 13 (December 18).

Registrar of the University of Birmingham—The Secretary, University of Birmingham, Edmund Street, Birmingham (January 1).

Part-time Teachers in Strength of Materials, Machine Design and Hydraulics—The Principal, South-West Essex Technical College, Forest Road, Walthamstow, E.17.

Mathematical Tutor in the Secondary School of the Gordon Memorial College, Khartoum—The Controller, Sudan Government Office, Oxford Hotel, 261 Clifton Drive South, St. Annes-on-Sea, Lancs. (quoting 'Mathematical Tutor').

Assistant Physicist at the Bradford Regional Radium Centre—The Medical Officer of Health, Town Hall, Bradford.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Indian Forest Records (New Series). Entomology, Vol. 6, No. 3: Possibilities of Control of Lantana (*Lantana aculeata* Linn.) by Indigenous Insect Pests. By Dr. C. F. C. Beeson and Dr. N. C. Chatterjee. Pp. iii+41–84. (Delhi: Manager of Publications.) 1·4 rupees; 2*s*. [111

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 237: On Coccids found on Roots of Plants in Egypt. By Mahmoud Hosny. Pp. iii+21+3 plates. (Cairo: Government Press.) P.T.3. [411

---

[1] Trueta, J., "Treatment of War Wounds and Fractures" (London: Hamish Hamilton, 1939).

[2] See Sandon, H., "The Composition and Distribution of the Protozoan Fauna of the Soil" (London and Edinburgh: Oliver and Boyd, 1927).

[3] *Særtryk Medd. om Grønland*, 64 (København, 1922).

[4] Giani R. *Giorn. R. Accad. Med. Torino*, 11, 165 (1905).

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, DECEMBER 7, 1940 No. 3710

BRITISH AGRICULTURE IN WAR-TIME

IT is all too true that as civilized life develops, its problems multiply and become more difficult to solve. In primitive agriculture man had but to contend with elemental forces that opposed him when he began to grow food, instead of merely hunting for it or gathering it. In modern agriculture we have not only to adjust our environment to the needs of particular crops and animals and to conserve soil fertility, but also to concentrate production in delimited areas to help maintain large industrial populations that live off the land, if not upon it. We have also to organize transport and distribution through a medley of middlemen and vested interests without causing the cauldron of social unrest to boil over. In war-time these problems are aggravated by disorganization of labour and transport, and by the vital need of producing as much food as possible in proximity to consuming centres.

Owing to the neglect of agriculture, to the huge growth of the industrial population, and to developments in submarine and aerial warfare, Great Britain is now at pains to maintain her food supplies ; and the difficulties of to-day are greater than those experienced in 1914, because since then we have lost some 2¼ million acres of arable land and about one quarter of our agricultural workers, large areas of grassland have become derelict, death duties have deprived the land of capital and unpredictable prices have badly handicapped the progressive farmer. Our shipping, overseas investments, and exports have all declined. On the other hand, science applied to agriculture has shown how yields of many crops, including grass, can be increased, and how numerous plant and animal pests can be controlled ; farm labourers are better paid, and the output efficiency per worker has increased ; the number of agricultural tractors has increased by 44 per cent since September 1939 ; so far, there has been very little reduction in livestock numbers, and good stocks of essential foodstuffs have been stored, for man if not for beast.

The chief agricultural problem of the moment is the production of more home-grown human food, and closely related thereto are the problems of feeding-stuffs, prices, and labour. The weekly wage of the farm worker has been raised to a minimum of 48*s*., and although 70,000 workers left the land for other pursuits in the first ten months of war, this leak has now been sealed. Unremunerative prices have long been the bugbear of the farming community, and to-day price-fixing at profitable levels is vociferously demanded. Notwithstanding efforts of the legislature to make farming profitable by means of the Wheat Act of 1932, sugar-beet subsidies, and marketing boards run by producers, the outlook for farming has remained precarious, and ever mindful of his bad experience when the Corn Production Act was repealed in 1921, the farmer is naturally anxious for the future. There can be no argument that in peace-time *efficient* farming must be made remunerative ; but too great and too frequent insistence on having good prices now, when many are sacrificing far more than their worldly wealth, is apt to alienate the sympathy of the urban electorate, upon whose votes the future prosperity of farming will depend. There is, however, no question that our farmers may be relied upon to pull their weight in the present emergency ; and they will be encouraged by the recent assurance of the Minister of Agriculture that the present system of fixing prices in advance will be continued throughout the War and for one year afterwards.

The provision of fodders and feeding-stuffs for livestock is especially important, because it affects the dietary of the whole nation. Thanks to a favourable climate, we produce sufficient grass and hay for nine months' supply, but the production is seasonal and the gap is filled largely by importing 'concentrates' (cereals, cereal offals and oilcakes) to the tune of about 9 million tons a year. These concentrates occupy much shipping space and involve currency payments abroad. Munitions of war and food for direct human consumption being of prior importance, we must now seek to compensate restricted imports of concentrates by growing more fodder at home, by eliminating wasteful feeding, and by reducing flocks and herds consonant with diminished imports. Now increased production of home-grown fodder competes with food production for direct human consumption, and it is well known that feeding man through animals involves great loss of nutrients; for example, it takes 10 lb. of concentrates to provide 1 lb. of butter, and up to 20 lb. of wheat to produce 1 lb. of beef. Hence, in war-time, arable land growing human food is more important than grass or arable land growing food for stock.

One of the meritorious achievements of the Ministry of Agriculture has been the ploughing-up of more than two million acres of grassland in the first nine months of war, a good proportion of which has been used for growing oats and wheat. It is now planned to break up a further million acres of grassland, the selection of which will be much more difficult than the first two millions. No definite guidance has been given as to how newly broken land is to be cropped. The cropping must depend to some extent on the local conditions, but it seems reasonably certain that the bulk of it will be devoted to growing cereals, and increasing the acreage under potatoes, which so far have been somewhat neglected, leaving comparatively little for growing roots and other animal fodders. Some leeway may be made up by growing kale and catch crops of rape, rye, late-sown barley, etc., and, in general, higher yields can be obtained by a more liberal use of nitrogenous and phosphatic fertilizers. Various suggestions have been made for increasing supplies of home-produced feeding-stuffs, such as utilization of all slaughter-house offals, predigestion of straw with alkali, and ensiling a million tons of grass for winter feed, but Dr. Norman Wright has already shown (NATURE, Aug. 24, p. 251, and Nov. 30, p. 712) that little substantial help can be expected from these sources, or even from the adoption of minimum standards of feeding ordinary rations.

The Minister of Agriculture has recently stated that during this winter allocations of feeding-stuffs not grown on the farm will probably be reduced to 70 per cent of normal supplies for dairy cattle, to about one half for other cattle and sheep, and to one third for pigs and poultry. This ruling is in line with the policy followed in Great Britain and in Germany during the War of 1914–18, and by Germany in Denmark and Holland at the moment; it means a gradual slaughtering of livestock (except milch-cows), pigs and poultry being the first to suffer.

There is, however, something to be said for the view, shared by many, that pigs or poultry, or both, should have precedence over beef-cattle. The late Mr. Christopher Turnor, whose death is a great loss to British agriculture, recently stated that for more than ten years he had produced "excellent grass-fed beef and mutton on heavy clay pasture, properly treated, without using any imported cake or concentrates whatever". It would be encouraging to think that this practice could be, or would be, followed at all generally; nevertheless, it suggests one means of helping to maintain our best beef-cattle and sheep. It therefore looks as if the Briton's dietary will gradually shift, at least during the war years, towards lactovegetarianism; and there is little doubt that the national health would not suffer thereby. A large proportion of our adult population, in particular sedentary folk and those who neither toil nor spin, could well give up half the meat they normally eat, and thrive on a dietary supply of some 60 gm. of protein a day (instead of the usually accepted 100–120 gm.), provided, of course, that other nutritional elements, especially vitamins and minerals, were consumed in adequate amounts.

The severe troubles of British agriculture, which began when cheap wheat from North America began to flood our markets in the late eighteen seventies, have never been boldly tackled by Government, and they have been aggravated by the intractable individualism of the farmer. Lack of vision on the part of our rulers has been the keynote of most of our lack of successes. In agriculture the need has always been for a comprehensive long-term policy, and one which would be compatible with war-time as well as peacetime conditions; instead of it, we have been treated with what Lord Bledisloe calls "hectic legislative patchwork". The outbreak of war in 1914 found us unprepared in almost every department of State, including agriculture. It was not until 1917 that the newly created Food Production Department began its successful labours; but even this, as Sir Thomas Middleton has recently told us, was handicapped by the delay in adopting a policy. Delay and makeshift are the inevitable concomitants of lack of vision; and the story has been repeating itself to some extent during 1939–40. Although the present War began to brew in 1933, practically the only serious preparatory step taken in the agricultural field was the creation of the Food (Defence) Department, which reported in 1938. Up to June 1939, only 150,000 acres of grassland had been broken up for arable production, and tractors were in short supply for war-time purposes. The Government had indeed subsidized the use of lime and basic slag in the interests of soil fertility, but these were home productions, and so the opportunity to increase the reserves in the soil of those nutrients which are mainly imported was missed; and scarcely a beginning had been made with the drainage of water-logged land. The allotment movement, which reached its zenith during 1918–19, was allowed to languish, and no stimulus was given to increased production of vegetables, especially of onions and carrots, which were mostly imported. No plans were made to develop the results of research, conducted by private interests, on ensilage, the use of straw as fodder, or that of urea or ammonium bicarbonate for rectifying protein deficiency in the rations of milch cattle.

This list of omissions is not complete, and the recital of it is distressing, but it will serve to indicate the lamentable shortcomings of past agricultural administrations. The faculty of foresight or prevision is not one that is easily developed; it is, however, a distinguishing feature in the mental equipment of the gifted scientific research worker, and it may therefore be suggested that the inclusion within the administrative body of one or two outstanding men of this type might prevent the recurrence of past ineptitudes. It may be that there is little transfer of insight and predictive ability from scientific research to politics and sociology; experiment alone can decide, and it is worth trying. The fact that the few scientific men who have been elected to Parliament in the past have failed to leave their mark on policy is no evidence to the contrary, because it is not knowledge of science that is the essential qualification—useful though this may be—but sound judgment and ability to look ahead. Improvisation has its place in the casualty ward and on the music-hall stage, but in the sphere of political control it is weak and dangerous. In agriculture at least we must have insight, foresight, and long-term planning.

NUTRITION IN THE HOME

The Nation's Larder and the Housewife's Part Therein

A set of Lectures delivered at the Royal Institution of Great Britain in April, May and June 1940, by Prof. J. C. Drummond, Maj.-Gen. Sir Robert McCarrison, Sir John Orr, Sir Frederick Keeble, Dr. L. H. Lampitt, Prof. V. H. Mottram, Dr. J. C. Spence; with a Supplement by Dr. Franklin Kidd. Pp. xii + 146. (London: G. Bell and Sons, Ltd., 1940.) 2*s.* 6*d.* net.

"THE Nation's Larder" offers to the inquiring housewife much food for thought, perhaps not very easy for her assimilative capacity. A preface by the President of the Royal Society and a letter from the Minister of Food stimulate an appetite for the substantial courses to follow.

It is agreed that in days long past the British peasant's larder was most satisfactorily stocked with a few simple sustaining foods, dairy produce, coarsely ground meal, potatoes, green and root vegetables. In recent years the larder was more variously but less adequately filled, and the nation's health and teeth have suffered from the consumption of *sophisticated* foodstuffs. War enforces a reversion towards a debased form of peasant's diet, debased because the bread and cereals of which it substantially consists have been deprived of essential ingredients. The majority of the British public are content with white bread, and the few who want wholemeal now have difficulty in getting it. There is an official scheme to reinforce white flour with synthetic vitamin B_1 (aneurin) and calcium, but that will not restore the protein, the iron and other minerals, and vitamins A, B_2 and E removed in milling.

There are two ways of reforming a bad diet. The best method, that advocated by Sir Robert McCarrison, is to rebuild it on the lines of the peasant diet. Another less satisfactory method is to keep the bad diet and supplement it with those foods misleadingly called *protective.* The classification of foods into three groups, energy producing, body building and protective, as adopted by Prof. Mottram on pp. 99 and 100, is with good reason adversely criticized by Dr. Spence on p. 113, in his most helpful section on the feeding of children. *Whole*some foods like dairy produce, whole seeds and vegetables are not only protective but also energy giving and body building. The artificial grouping into three classes would be meaningless had not certain refining processes, such as the roller milling of grain, the preparation of concentrated sugar and of pure fats and oils, created a new class of *unwhole*some foods which serve solely as fuel and do not feed the living tissues of the body. A grave error on p. 100, repeated again on p. 108, is the omission of that most protective group of foods, *whole* seeds and their products. These, the peasant's mainstay, are insufficiently stocked in the larders of to-day.

As a method of supplementary feeding suitable for ill-nourished mothers and school children, several of the authors commend the 'Oslo breakfast', a peasant type of meal of wholemeal bread, fruit, salad, raw carrot, milk, cheese, yeast, etc. But why go so far afield for a model while in our country there is that excellent working model the 'Glossop lunch' used successfully by Dr. Milligan, medical officer of health for Glossop, before Oslo breakfasts became famous.

Despite the merits of the peasant diet there is no justification for refusing to profit by the benefits which applied science, industry and commerce offer. Canning and chilling of foodstuffs, their transport from overseas and preparation in bulk by factories can now be achieved with less loss of nutritive value than home produce suffers in distribution and kitchen handling. The supplement by Dr. Franklin Kidd on the artificial preservation of food is of great interest.

The provision of a diet fully adequate for the health of every family will, says Sir John Orr, enable us to carry through post-War reconstruction with the minimum of strife. For the development of home food production, Sir Frederick Keeble and Sir Robert McCarrison stress the need for better attention to the land. Crop yields can be doubled in quantity and improved in nutritive value if the soil is properly fed and aerated.

Every corner of the nation's larder and its sources of supply are thus carefully scrutinized, but apart from her function as milch cow the housewife's part therein is ill-defined. In fact it seems that as cook-housekeeper she should be superseded by the large-scale caterer, for Dr. Lampitt insists on the advantages of communal feeding "to cater for a million is to save the nation's wealth". VIOLET G. PLIMMER.

ANATOMICAL EMBRYOLOGY

A Manual of Embryology

The Development of the Human Body. By Prof. J. Ernest Frazer. Second edition. Pp. x+523. (London: Baillière, Tindall and Cox, 1940.) 30*s*.

STUDENTS of the development of the human embryo will welcome the new edition of Prof. J. E. Frazer's "Manual". The general plan and scope of the work has not been altered by the changes and additions which have been made since it first appeared. It is a book which keeps close to its subject-matter—human embryology for the medical student and anatomist. Thus Prof. Frazer eschews both histology and comparative morphology. Of the anatomical facts which come within its purview, the book gives an account which is not only comprehensive and thorough, but also in several respects original. The author in his preface points out that in several places his descriptions will be found to diverge from embryological orthodoxy, and emphasizes that these divergences are the result of his own extensive researches. The work is, in fact, an original contribution as well as a text-book, and it will therefore be doubly interesting to the advanced worker. It is, however, unfortunate that no references are given, so that the student may find it difficult to distinguish the more original and controversial parts from the more conventional; but this is a comparatively minor danger which can easily be surmounted if the book is used under the guidance of a teacher.

There are several other reasons why the book is scarcely suitable to serve a student as his fundamental text-book. The very fact that it is partly a presentation of original research has had the more or less inevitable result that the allocation of space, and the fullness of the treatment of different subjects, has been influenced by the interest they hold for the author. For example, one notices a very excellent discussion of the derivatives of the pharynx, which is on quite a different level of completeness from the descriptions of the eye and inner ear. Moreover, there are some parts of the subject in which it is at present probably impossible to give a completely satisfactory account without more comparative material than the author allows himself. Examples are the earliest stages of development and implantation, in connexion with which a consideration of the recent work of Streeter and the Baltimore school must be considered as almost a necessity ; and the formation of the placenta is a topic for which comparative material is even more than usually illuminating.

One may doubt, indeed, whether it is possible to draw any general principles from a study of development which confines itself strictly to human material. Certainly our understanding of the basic anatomical processes at work during embryogenesis has in recent years been advanced mainly by studies on other forms. The demonstration of the reality and importance of cell streams is a case in point. For a complete account of embryology, suitable to provide the main guide to a young student, some consideration of these fundamental processes is essential.

The foregoing remarks are, however, not so much criticisms of Prof. Frazer's book as descriptions of the limits of the field with which he deals. Within those limits the book can be heartily recommended. It is an excellent, if not entirely orthodox, work of reference for the biologist who finds himself in need of embryological information, and it will be stimulating and illuminating supplementary reading for the student. C. H. WADDINGTON.

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharge in Gases

By Prof. Leonard B. Loeb. Pp. xviii+717. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 42*s*. net.

IN recent years the subject of electrical discharge in gases has entered upon a new and active phase. The burst of activity which was followed by J. J. Thomson's first classical treatise early in this century was ultimately slowed up because the presence of gas essential to the phenomena was in itself a stumbling-block, since it introduced variables not capable of independent experimental control. The focus of attention thus passed in subsequent years from self-maintained discharge to the relatively simpler phenomena in high vacua, with most valuable consequences, both theoretical and experimental. The position then reversed itself in that it was in the details of mechanism of high vacuum phenomena that our knowledge became so much more definite. The time was then ripe for a return to the more complicated problems arising from the introduction of gas at relatively high pressures; helped no doubt by industrial applications of glow discharge much new data has been accumulated during recent years and a critical treatise in the English language embodying these results and relating them to the familiar early work was much needed. Prof. Loeb's volume supplies this need, and the treatment is helped by the fact that the author himself has personally carried out or directed valuable researches on many of its aspects.

The volume opens with a description and discussion of measurements of the mobility of ions, later followed by a special chapter on electron mobility and a very full treatment of recombination. The problems of electron energy distribution, the theory of probes, ionization by collision, the part played by positive ions are all fully discussed, as of course it is necessary that they should be in leading up to the remaining third of the book on disruptive, corona, arc and glow discharges.

There will be few readers who will not find new material in this work and to most it will prove to be full of information, much of which may have passed unnoticed by them in its original form in scientific journals.

It is still true, of course, that in many of these phenomena, with which all physicists are familiar in broad outline, no finality can yet be said to have been reached. The author himself prefers to call his work a monograph rather than a textbook, and adds that in a book of this nature he figuratively lays the cards on the table, presenting the reader with facts and conflicting views and throwing "the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance".

But the reader will perhaps feel in consequence that the work is in some parts a little overloaded with controversial detail and a touch of special pleading for the acceptance of the author's results or conclusions rather than those of other workers. On the other hand, nothing is more exasperating to the non-specialist, seeking information, than the other type of handbook, not uncommon, which gives him all the published data, without that analysis of conflicting results from which he can then make his own choice.

Sufficient has been said to indicate the value of this work to any physics library. There remains only one point on which the reviewer wishes to express his personal views. The author states in his preface: "In writing a book of this scope it is obvious that too much emphasis cannot be spared for style or for a detailed consideration as to the best organization in presenting the material. The need is for a critical compilation of the state of physical knowledge in the various fields to-day." One can appreciate the task of analysing and correlating the mass of data provided in this volume. But to the reader himself style and presentation of material are very important, and he may feel that had the author been in a position to spare the time, the volume could have been pruned without loss of conciseness and with some improvements in its arrangement. Again, the use of italics for purposes of emphasis is valuable. But when it is used fifty times in ten pages (pp. 419–428, taken at random) its effect on the reader may not be quite what the author intended.

AN INTRODUCTION TO MATHEMATICAL ANALYSIS

Advanced Calculus

By Dr. C. A. Stewart. Pp. xviii + 523. (London: Methuen and Co., Ltd., 1940.) 25*s*.

WITH the ever-widening scope of modern mathematical analysis and its many ramifications, it is quite impossible to include, in a single volume of reasonable size, an adequate and exhaustive discussion of the calculus in its more advanced stages. It therefore becomes necessary, in planning a thoroughly sound course in the subject, to consider several important aspects of the vast field confronting a modern writer. The limitation of space renders the selection of subject-matter fundamentally dependent upon the aim of the course, which may or may not be related to the content of specific examination syllabuses. Logical development, too, may lead to the inclusion of many topics which, at present, may only be of academic interest, while others, of greater practical value, may have to be omitted. The experience and training of the writer may also have, more or less, a bearing on both these considerations.

With such thoughts in mind, it is interesting to turn to Dr. Stewart's volume, in which a good course, especially useful to students reading for mathematical honours, is thoroughly well laid out. The author fully appreciates his difficulty in selecting from such a vast field for, in his preface, he states: "Although this book is intended for students who have already acquired some knowledge of the elements of the calculus, it must be regarded merely as an introduction to the more advanced parts of the subject."

Although the subject-matter of a first course is included, the earlier concepts, regarded as intuitively obvious in many cases, are later re-examined in order that they may be satisfactorily founded upon a rigorously valid basis. Space has, however, only permitted the author to deal with those fundamental theorems which are essential to the developments considered or are likely to be needed in important applications. The first five chapters are devoted to the usual rigorous course in calculus up to the integration of functions of one variable. Then follow chapters on Jacobians; indeterminate forms, maxima and minima; vectors, twisted curves and tensors; multiple integrals; functions of a complex variable, conformal representation and contour integration; infinite series, products, expansions, infinite integrals and non-convergent series, and finally, Bernoullian polynomials, gamma and beta functions, the formulæ of Binet and Gauss, and Dirichlet's integral. Only the simplest theorems relating to the theory of sets, Lebesgue integration, finite differences, tensors, one–one correspondence, analytic continuation, etc., have been given. Importance is rightly attached to the approximate forms of functions, approximate integration and summation of series, but here again space has only allowed fundamental results to be dealt with.

From this very brief outline it will be seen that the scope of the course is wide. It has been skilfully planned and clearly presented, the diagrams deserving a special word of commendation. Many worked examples, often connected with important applications, are provided, and each chapter is supplied with appropriate exercises for the student's practice. Answers to these, where relevant, are also given.

It will be observed that no attempt has been made to include the theory of differential equations or of the functions that arise directly from them. It is hoped, however, that Dr. Stewart will consider the possibility of providing a companion volume devoted to this essential subject for, in the modern exploration of analysis, there is a tendency to overlook the supreme practical importance of this branch of mathematics, which really forms the very foundation of the higher stages of applied science. Such a volume would certainly be needed to supplement much of the present course by students reading for honours in science, notably physics.

SCIENCE AND NATIONAL WELFARE*

By Sir William Bragg, O.M., K.B.E., F.R.S.

MANY events conspire to make the past year notable in the history of the Royal Society. Reference has been made to the majority of them in the Annual Report of Council, usefully supplemented by the Notes and Records which we continue to owe to our past Treasurer, Sir Henry Lyons. I do not propose to speak of them in detail, but on this occasion it does seem fitting to give further attention to one or two general matters of lasting interest.

One of these is personal. Fellows will have noted the long list of those whom we have lost, and the great names which the list contains. I have felt as I have been reading it that I have turned over the last leaves of a chapter that stands by itself. The present generation is quick to honour the names of J. J. Thomson and Oliver Lodge; but they cannot remember, as we older men can, the brilliant years when these men and their contemporaries were writing the chapter's first pages. What they wrote was eagerly read, their lectures were heard with rapt attention; they were the pioneers, and the men of science of that time, nearly half a century ago, streamed after them. All that is now a memory. The years have slipped away since their work was done, and we now look back on it as a separate entity, a noble event in the history of science, and of British science in particular.

There is no vestige of sadness in such a retrospect, nor any trace of feeling that our pride must be founded only on what has passed. I am sure that all those who like myself can recall the long years, and compare those that have gone by with those that are still ours, will say happily and proudly that our young men of to-day are maintaining in full force the tradition that they have received. They are writing a new chapter; and it is a chapter of a novel importance, because as they extend our record of the facts of Nature they find themselves compelled at the same time to consider a new problem—the relation of those facts to society and to the government of nations. Let me express my admiration of the willingness, vigour and ability with which the newer generation gets to work.

This same novelty is enlarging the range of work of our Society and is a second matter to which we are compelled to give serious attention. Our fellows have constantly given their services to public interests; it has often been pointed out that they are to be found in association with almost every department of government. But this year new moves have been made which may, and I hope will, lead to developments of the highest importance. The Report contains a notice of the recent formation of a Scientific Advisory Committee over which Lord Hankey presides, with a reference which in effect directs it to consider the advances of science in their relation to national welfare. The Committee reports to the Cabinet through its chairman. A Committee of similar nature but lesser scope was set up a few months ago to consider the scientific aspects of the food policy of the Government: it consists of well-known authorities on nutrition, agriculture and economy, with myself as chairman. This Committee reports to the Lord Privy Seal, and so to the Cabinet Food Policy Committee over which the Lord Privy Seal presides. The significant feature of these Committees is their close and direct association with the Cabinet, the central body that governs the nation.

Hitherto men of science have been appointed man by man to various Government departments so that they might act as useful items in departmental machinery. The new Committees are not parts of any executive body and have no executive power of their own. They exist to make recommendations, which must of course be practical and take full account of difficulties of execution. But they are not hampered by traditions, nor by set habits; they have time and freedom to consider the whole field of scientific knowledge and its possible influence on practice. The Scientific Advisory Committee, the more important of the two, is particularly well fitted to watch all occasions and opportunities for the employment of science in the service of the nation, and also for the continuous encouragement of that employment. The president of the Society and the two principal secretaries are in close touch with every branch of science; through the fellows of the Society which they serve they have a unique view of scientific progress. The three secretaries of the principal Research Councils of the Government, dealing with industry, agriculture and health, are in close touch with the chief national activities.

---

* From the presidential address to the Royal Society, delivered on November 30.

Thus a great opportunity is opened after long expectation; and the Royal Society is largely responsible for the development of that opportunity. We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within.

We remember that it is science itself, not men of science, that we are trying to lift to the high places. In that respect our movement is not selfish. We do not claim that men of science shall be entrusted with authority because they are men of science: we do claim that authority shall be exercised in the light of a knowledge which grows continuously, and with continual effect on politics, on industry, and on thought itself. If at present the only way to bring this knowledge into use is to treat men of science as consultants, let us take that way. But we shall be taking the better way if in all ranks of the State, and especially in those that have authority and set an example, we can arouse a general appreciation of the position of, and a constant understanding watchfulness on, the increase of knowledge and the uses that are made and can be made of it. It cannot be said that the general aspect of the nation towards the increase of knowledge is satisfactory. Science has become an integral part of our educational system, yet the changes that have been made are often ridiculously like the casting of sacrifices to following wolves. Science is not a devouring monster, but a means of service; it is a knowledge, gained by an irresistible tendency of man to examine his surroundings. It may be rightly or wrongly used. There is a prime danger if those who are in the position to use it rightly shut their eyes to its presence and its power, like an army which relies on bows and arrows when its enemies know how to use machine guns.

It is not universally or even sufficiently understood how important natural knowledge has become. It is true that in a vague way the nation is brought by the happenings of war to guess at the meaning of scientific research in every kind of enterprise. But still it would be difficult for most people to grasp the significance, much less the meaning, of the description of a fact like this: that the Royal Air Force could not carry out its operations without the knowledge resulting from the studies of cathode rays and electrons made by our physicists, which is equivalent to saying that by this time we might well have lost the War. Similar cases of cause and consequence could be quoted in numbers; they happen to be found more readily in relation to the sciences that deal with inorganic materials than those that deal with organic processes, and the military demand for physicists has been great because they are wanted to put physical discoveries into practice. But this discrimination is only accidental and temporary, and in fact the whole range of science is equally concerned.

Since experimental science has assumed such a commanding influence on all our affairs, so that we run the risk of great perils if we take no account of it, and leave its uses to others, let us say, less well disposed than ourselves, and, on the other hand, have opportunities of great benefit if we use it rightly, it becomes a first duty to direct our steps accordingly. Just as in former times schools and colleges were founded to train men for the service of Church and State, in ways which were appropriate to that high end, so now we have to see to it that the men are produced by our educational systems who can appreciate and act up to a new state of affairs. This can be done without jettisoning any of the fine instruction which has been a proud feature of our older systems.

I think that this is not essentially a matter of the rearrangement of school time-tables, or the building of scientific laboratories, though such tactical methods must have their due consideration. This is a personal matter, as has been the case with every great human movement. We have not to force the use of new tools, but to encourage and develop a new appreciation and a new attitude. Our best method, as ever before, lies in our own actions. If we, in the continually increasing contacts of men of science with public affairs, can show that we have something of great value to contribute, and that we give it freely, placing our individual interests below those of a greater purpose; if we try to understand the motives and principles of those whom we meet who may not see our vision, just as we may fail to appreciate theirs, then by so doing we have the best chance of bringing about the changes that we desire. It is the personal contact of the man of science, especially with those who are charged with duties to the nation, that is the moving force. That is where these new associations of science with government may mean so much, and shall mean it, if our devotion can achieve its purpose.

VENTILATION OF AIR RAID SHELTERS

By J. S. Weiner

Department of Industrial Physiology, London School of Hygiene and Tropical Medicine

THE occupancy of air raid shelters presents, actually or potentially, many of the whole range of problems with which the practice of ventilation is concerned. The term 'ventilation' is here used to include heating and other air-treatment; it may be defined as 'the provision of air hygienically and physiologically adequate in quantity and quality'. In air raid shelters conditions arise which tend to reduce the efficiency of ventilation very considerably. While on one hand, the supply of air is hampered in a number of ways by safety requirements, the demand tends at the same time to be greatly increased. Structural alterations to places used as air raid shelters usually require the blocking or baffling of the natural airways; lighting restrictions interfere further with ventilating arrangements; the danger of gas attack may reduce the available air supply merely to the air capacity of the shelter. The fitting of ventilating appliances may entail some structural weakening of a refuge; and the dependence of most large plants on outside power is also a potential source of weakness. Furthermore, since in shelters the ordinary density of living-room occupancy is much exceeded, satisfactory standards of ventilation are distinctly more difficult of attainment.

The specific problems of ventilation in air raid shelters may be appreciated, first by a discussion of the general requirements for adequate ventilation, and secondly, by an examination of the practical measures available to implement these particular requirements. The great variety in situation and capacity of shelters, and the lack of data of actual atmospheric conditions and circumstances of occupancy, even of a few types, restrict the scope of the discussion to rather broad generalizations. Although research over the last twenty-five years has added greatly to the scientific basis of ventilation, it will be clear that many matters to be mentioned here stand in need of thorough investigation. It is to be hoped, therefore, that the Horder Committee will set under way a comprehensive inquiry into shelter ventilation which will serve both as the prerequisite to effecting improvements and as means to valuable new information.

The general requirements for satisfactory ventilation with reference to air raid shelters may be considered under the following headings.

THERMAL COMFORT

The older ideas on the subject of ventilation laid great stress on the carbon dioxide in the air. But it is now well recognized that in ill-ventilated and crowded rooms the excessive warmth and stagnation constitute the chief causes of discomfort. Nevertheless, conditions may well arise in which the concentration of carbon dioxide is of paramount significance in regard to the adequacy of the air supply.

For comfort, the air should be cool rather than hot, dry rather than damp, moving rather than still, and variable in movement rather than uniform and monotonous[1]. The feeling of warmth experienced is related to four physical factors which influence the rate and mode of heat exchange between the body and the environment. These are: the dry bulb temperature of the air, its relative humidity, the mean (radiant) temperature of surrounding surfaces and the rate of air movement. The interrelationship between these factors and the sensation of warmth and comfort has been studied by workers in Great Britain and the United States[2,3], and has recently been reviewed by Bedford[4]. Some or all of the factors have been combined either in indexes which give due weight to each component or in the direct measurements of specially designed instruments. In air raid shelters it is probably best to measure the separate factors and then to use formulæ which give a combined assessment, if this is required. The separate measurements will usually give the clue to the most useful course of action, and in many cases combined indexes or special apparatus offer no advantage over the simpler readings.

In the evaluation of the separate or combined factors influencing warmth recent work[5] is capable of useful application to the conditions in air raid shelters. From an inquiry in which more than 1,500 sedentary workers, normally clad and doing light jobs, were concerned, data have been assessed showing the influence of the separate factors mentioned above on the conditions necessary for comfort. When the air was relatively still, the radiant heat from surroundings small, and the relative humidity about 50 per cent, 86 per cent of the opinions showed that conditions of comfort exist within the zone of 62–68° F. dry bulb temperature. Higher air or radiant temperatures and relative humidity increase the sensation of warmth, but they can be counteracted by the increased cooling effect of air movement. Cold sensations, on the other hand, may be due to increased air movement, to low temperatures of surfaces, or low air temperatures, and accordingly may be countered by higher air temperatures, or sources of radiant heat, and slightly by increased humidity. These findings relate to persons, mainly sitting, and doing very light work while wearing ordinary indoor clothing. In air raid shelters where people are at liberty to wear extra clothing to maintain bodily warmth, temperatures somewhat below those of the working 'comfort zone' will probably be endurable.

In air raid shelters all four factors are liable to considerable and sometimes independent variation, according to the outside thermal conditions, the rate of air change, the warming effect of the occupants, the length of occupancy and the heat transmission coefficients of the walls. In warm weather with inadequate ventilation and depending on the number of occupants, air temperatures of shelters will tend to rise to uncomfortable limits ; this effect will probably be of less magnitude in underground shelters, since the walls remain appreciably cooler than the air[6]. The capacity of the ventilation and surroundings of shelters for removing bodily heat so as to prevent its undue accumulation is clearly one important criterion in assessing the permissible number of occupants and the length of stay. This basis has been adopted in the official publication referred to below.[13]

In cold weather the heat of metabolism of the inmates makes an important contribution to the warming of the shelter. If fresh air supply is poor or is deliberately reduced, the temperature may even become unpleasantly warm. But the closing up of all openings as a means to increased warmth interferes with other important objectives of ventilation. Hence extra warming must be sought rather in higher radiant temperatures or in heating the incoming air.

In inadequately ventilated air raid shelters, the continuous addition to the atmosphere of moisture from the expired air of the occupants will tend to raise the relative humidity. But as the walls of underground shelters are some degrees cooler than the air, the rise in humidity will be slowed by the surface deposition of moisture[6]. This will probably hold true also for surface shelters in cold weather. Nevertheless, accumulation of moisture in some circumstances may constitute an important contributory cause of discomfort. At temperatures above 70° F. with relative humidities above 70 per cent feelings of clamminess arise[5]. Below the lower limit of the comfort zone increased humidity is of less importance. Hence the necessity for dealing with this source of discomfort, by proper spacing, increased air change, and in some situations by absorption of moisture by dehydrating agents. Besides the comfort zone laid down by Bedford and his index for combining the various factors—'equivalent warmth'—the American 'effective temperature' scale which combines the effects of dry-bulb temperature, humidity and air movement[2,3] may be a useful one to adopt in shelters. The winter comfort zone in terms of effective temperature for British subjects is about 54–68° F.[5] The summer comfort zone is probably about 6° higher.

FRESHNESS

The environmental factors which contribute to the impression of stuffiness or freshness have recently been analysed by Bedford and Warner[7]. Observations have shown that one of the important factors is the rate of movement of the air ; at velocities below 20 ft./min., feelings of stuffiness are likely to arise. Not only the average velocity but also the variability of the air currents are important. The relative humidity should be kept below 70 per cent. Stuffiness can also be produced by the combination of cool walls and warm air. Yet another cause is the existence of temperature gradients, higher at head-level than at foot-level. In air raid shelters all these factors are likely to operate, unless adequate ventilating measures are instituted. High relative humidity, cool wall and warm air combinations, temperature gradients, were all noted in a recent investigation in shelters[6].

FREEDOM FROM ODOURS

In satisfactory ventilation, the cubic space per person and the supply of fresh air are arranged to keep the air free of objectionable odours. In fact this has been a main criterion of adequate fresh air supply for almost a century. American workers[8] have lately shown that the amount of fresh air required per person varies according to the amount of cubic space available ; the ventilation requirement increases as the space per person decreases, and is also closely related to personal cleanliness. In ordinary circumstances 1,000–1,200 cub. ft. per head per hour will give good results. A reasonable lower limit would probably be about 600 cub. ft.

In air raid shelters objectionable odours arise from a variety of sources, and are to be associated with primitive sanitary arrangements, the presence and preparation of food and the crowding of the occupants. The sensitivity to odours varies considerably, and the harmful effects attributable to odours are probably only indirect, as for example, loss of appetite leading to other disturbances.

Measures to mitigate the nuisance include adequate spacing, and standards of air supply or air changes, and also the use of deodorants or volatile substances which 'mask' the smell complained of.

Oxygen and Carbon Dioxide

Although the old practice of prescribing standards of ventilation according to the concentration of carbon dioxide was based on a misplaced emphasis on the ill-effects of this gas, in air raid shelters the concentration may quite easily reach levels undesirable in themselves and indicative as well of gross inadequacy in comfort and epidemiological standards. The sensitivity to high carbon dioxide percentages in the inspired air varies among individuals, but beyond 2–3 per cent panting and distressed breathing are the early signs of the physiological effort made by the body to prevent the carbon dioxide tension of the blood from rising outside tolerable limits. With carbon dioxide above 6–7 per cent, symptoms of carbon dioxide excess become serious. In places where the carbon dioxide due to combustion and respiration is not being removed fast enough, progressive lowering of the oxygen content will also prevail.

High carbon dioxide concentrations will affect the body first; but the oxygen deficiency will in due course prove even more serious. At a concentration of 12–13 per cent oxygen, oxygen lack will be superimposed on the carbon dioxide excess. The sealing-off of shelters in a gas attack represents a situation where oxygen supply and carbon dioxide removal may assume an importance even beyond the dissipation of heat, since in underground shelters the rise in air temperature is not as rapid or as serious as that of carbon dioxide[6]. In a fully occupied shelter with all openings blocked, signs of distress became manifest after two hours, and absorption of carbon dioxide and release of extra oxygen from cylinders were necessary to prevent the ill-effects.[6]

Hence, for those shelters which are to be sealed against gas attack and are not provided with mechanical ventilation with filtration, careful calculation must be made of the rate of accumulation of carbon dioxide to set limits to the number of occupants and time of occupancy. In this connexion, 1 per cent carbon dioxide should be regarded as an upper limit, whilst in assessing 'ordinary' ventilation on this basis, 20 parts per 10,000 should not be exceeded. For the purpose of this calculation in the case of sealed shelters, the production of carbon dioxide can be taken at about 0·6 cub. ft. carbon dioxide per hour for a man sitting quietly. In determining the available air on the basis of the volume of the shelter, the fittings and volume due to the bodies of the occupants should be deducted, for in crowded shelters the proportion of non-available space is fairly high. In a steel shelter of gross capacity of 1,210 cub. ft., 200 cub. ft. had to be deducted for fittings and the bodies of the forty-five occupants[8]. An upper limit of 20 parts per 10,000, it can be calculated, means an air supply of about 400 cub. ft. per hour per person.

Spread of Infection

The floor space and air supply influence not only the standards of comfort, freshness, and freedom from odour, but also the spread of communicable disease. Two modes of spread are recognized: dissemination by exhaled droplets and the aerial transmission of infective particles.

In both types space is of obvious importance. Vernon[9] mentions that for school children at least 180 cub. ft. per head is desirable and in theatre and assembly rooms not less than 90 cub. ft. In shelters in which 50 cub. ft. per person only may be available, it is clear that air exchange and treatment of the air will have to be adequate to compensate for the reduced accommodation.

What standards of fresh air supply should prevail to reduce the number and contacts of infective particles is not accurately known. A comparison between 900 and 1,700 cub. ft. of air per hour per person showed no effect of reduced ventilation on the incidence in respiratory illnesses amongst school children[10]. The ventilation prevailing in air raid shelters will fall in most cases well below the London County Council standard of 1,000 cubic feet per hour (the official recommendations allow very much lower standards). Air change may even become nil when air raid shelters are sealed off from gas attack.

Hence the use of air disinfectants becomes a most important measure for supplementing the available space and air supply. The relative merits of various air disinfectants have been the subject of recent research which indicates promising results from the use of several phenolic germicides and hypochlorite solutions[11].

The necessity of proper warming or cooling of shelters is of obvious importance also in relation to infection. Sudden chilling, due to cold walls, on one hand, and warm and humid atmospheres acting on the mucous membrane of the breathing passages, on the other, favour increased susceptibility to infection.

Dustiness

The presence of dust can contribute to bacterial pollution of the air. As an irritant to the nose and chest it can be responsible for sneezing and coughing, which in crowded shelters will be a main source of infective matter.

PRACTICAL CONSIDERATIONS

The attainment of satisfactory conditions of ventilation depends in practice, as the foregoing discussion of the basic physiological and hygienic principles has emphasized, on the mutually interdependent factors of spacing and air supply, and on the employment of various measures of air treatment. A two-fold approach to the problem of improving the situation in air raid shelters is thereby suggested: the allocation of space per person in relation to the available or projected facilities of fresh air supply and, secondly, the complementary institution of a number of procedures of air treatment.

A clear distinction must be made between the different systems of ventilation, since the particular arrangement available is the main factor determining the eventual occupancy. 'Mechanical' ventilating systems employ fans and accessory mechanical appliances for changing the air; in 'natural' systems the air is exchanged under the influence of naturally occurring pressure differences due to fires and other heating arrangements combined with the ordinary disposition of windows, doors and other openings. In air raid shelters the further distinction must be made, in either case, as to whether or not protection against poison gas is a feature of the ventilating system. In the case of 'naturally' ventilated shelters, protection against gas implies that the shelter can be made gas-tight, and consequently the limit of the available 'pure' air is represented by the volume of the shelter.

In a sealed shelter it is, of course, quite feasible to replenish the used air from cylinders of compressed oxygen or air as well as to remove accumulating carbon dioxide by means of a suitable absorbent. This *regenerative* method, which can scarcely be of widespread use, is well worth considering as an emergency measure in control posts[6]. Protection against gas may also be provided in mechanical systems of ventilation by means of suitable filters.

In general, it may be said that the permissible accommodation should be determined according to which of the four arrangements obtains, natural or mechanical, in either case whether gas-protected or not. In the case of mechanical systems it is obvious that the design and capacity of the plant permit immediate application of standards based on the hygienic considerations outlined above. The number of occupants in a shelter with known mechanical ventilation is readily stipulated. For naturally ventilated shelters it is, of course, very difficult to indicate in advance the details of suitable arrangements of doors, windows, space, etc. Here, pending direct investigation of the shelter itself, occupancy must be on the basis of a reasonable floor space, while accessory measures must be vigorously employed. When dealing with naturally ventilated shelters intended also to be sealed off, definite standards can be laid down beforehand, based on the dimensions of the shelter. As we have seen, it is easy to calculate the rate of accumulation of carbon dioxide and the density and time of occupancy before maximum standards are approached. In addition, the rate of increase of air temperature can also be estimated, so that the necessary surface area for heat dissipation up to a limiting temperature can be stipulated.

In accordance with these four situations, the official recommendations would appear to give reasonably good general guidance, although the standards in most cases are admittedly minimal. Air Raid Precautions Memorandum No. 10[12] lays down that in shelters naturally ventilated (and to accommodate more than twelve persons) there must be per person:

Not less than 6 ft. sq. of floor area.

Not less than 50 cub. ft. capacity.

Not less than 25 sq. ft. of all walls backed by earth.

These standards may be reduced to 3¾ sq. ft. floor area per person provided the shelter is ventilated mechanically at a rate exceeding 450 cub. ft. of air per person per hour.

The first set of provisions, having regard to the hygienic requirements set out above, would require the most efficient cleaning, disinfecting, and other local treatment of the air to counteract the low rate of ventilation and minimal spacing. First-hand investigation would indicate how sufficient in practice natural ventilation proves in the larger shelters inhabited on this basis. The value of accessory measures in relation to these standards should be ascertained in the light of practical experience, and both the standards and these measures improved if necessary.

The standard for mechanical ventilation of 450 cub. ft. per hour, even though a higher degree of crowding is permissible, would appear superficially more in accordance with general practice. Nevertheless, accessory measures, such as aerial disinfection and the allaying of dust are of first-rate importance.

For sealed (unventilated) and gas-protected mechanically ventilated shelters, standards of accommodation have been laid down in relation primarily to heat dissipation and carbon dioxide accumulation. These are set out quite comprehensively in Air Raid Precautions Handbook No. 5[13]. Depending on the dimensions of the room, the number of occupants permitted for 3 hours and 12 hours occupancy is shown in relation to sealed shelters or air supplied mechanically at 150 cub. ft. and 450 cub. ft. per hour. The square feet of area allowance per person under these conditions are in general much more satisfactory as regards hygienic requirements, particularly protection from spread of infection. It might almost be suggested that all shelters should be assessed for occupation on the basis of the eventuality of gas attack. On the official standards, and in ordinary circumstances, standards of spacing and air change would be universally of a much safer order.

Whatever the conditions, there can be no doubt of the importance of utilizing every available method of improving the properties of the air by local and 'emergency' measures.

With regard to freedom from infection, such measures include the thorough cleaning of the shelters with soap and water, or the treatment of the floor with spindle oil, the removal of dust by vacuum cleaning, and, most important, the use of air disinfectants. Although other precautions, such as medical inspection, isolation of suspected cases and prophylactic inoculation are of great importance, their discussion is perhaps out of place here. The wearing of face masks in overcrowded shelters would seem to offer a good measure of protection against droplet infection and would seem well worth a trial. Such masks should not prove uncomfortable even for long periods if worn loosely, much in the style of a veil.

With regard to conditions of comfort and freshness, a number of useful measures may be suggested. In shelters in which the air is too warm, care must be taken that the natural air flow is not being obstructed. Wherever possible all openings should be used to their maximum advantage, and in cold weather unpleasant draughts along the floor can be avoided by the judicious placing of screens near the doors. The incoming air may be assisted by locating a source of heat under a chimney pipe or the emergency exit. An oil lamp used in this way would also provide some lighting and warmth. Oil-stoves and electric radiators, or other heating appliances should be installed where air or wall temperatures are excessively low. A radiant source will be most useful where very low wall temperatures obtain. No braziers or slow combustion stoves should be used owing to the very great danger of carbon monoxide poisoning.

Discomfort due to stagnation of air and high air temperatures can be reduced considerably by stirring the air. Where electric fans are not obtainable an improvised fan may be operated after the fashion of the punkah. Stirring of the air will help to dispel undesirable temperature gradients and so reduce the sense of stuffiness.

Proper sanitary accommodation as well as restriction on preparation of food in the shelter itself are of first importance in dealing with smell nuisance.

[1] Report of the Health of Munition Workers' Committee (H.M. Stationery Office, Cmd. 9065).

[2] Houghton, F. C., Teague, W. W., and Miller, W. E., *J. Amer. Soc. Heat. Vent. Engrs.*, 32, 315, 473 (1926).

[3] Yaglou, C. P., *J. Indust. Hyg.*, 9, 297 (1927).

[4] Modern Principles of Ventilation and Heating. (London: H. K. Lewis and Co. 1937).

[5] Bedford, T., "The Warmth Factor in Comfort at Work". Indust. Health Res. Bd. Rept. No. 76. (H. M. Stationery Office, 1936).

[6] Report on Occupancy Tests of Air Raid Shelters for Factory Workers. (London: H. K. Lewis and Co. 1939).

[7] Bedford, T., and Warner, C. G., *J. Hyg.*, 39, 498 (1939).

[8] Yaglou, C. P., Riley, E. C., and Coggins, D. I., *Heating, Piping and Air Condit.*, 7, 65 (1936).

[9] "Principles of Heating and Ventilation". (London: Ed. Arnold and Co., 1934).

[10] New York Commission on Principles and Practices of School Ventilation. (Columbia University, New York, 1931.)

[11] Twort, C. C., Baker, A. H., Finn, S. R., and Powell, E. O., *J. Hyg.*, 40, 253 (1940).

[12] Air Raid Precautions Mem. No. 10. Provision of Air Raid Shelters in Basements. (H.M. Stationery Office, 1940.)

[13] Air Raid Precautions Handbook No. 5. Structural Defence. (H.M. Stationery Office, 1939.)

RECENT IMPRESSIONS OF WAR-TIME AMERICA

By Dr. Joseph Needham,

University of Cambridge

As the result of long-standing invitations to attend the Second Conference on Differentiation and Growth at Salsbury Cove, Maine, and to lecture at the Californian universities (Stanford and Berkeley) on my own subject, I spent a period of five months (June–October) last summer in the United States, during the course of which I visited some twenty universities and colleges. I was glad to take the many opportunities which offered themselves of speaking on the present position of science in Europe. In this I dealt both with the situation of science in British democracy at war, the organization of the scientific contribution to the national effort against the Nazi-Fascist powers, the effects on the universities and similar institutions, etc., and with the nature and origin of the Nazi attack on all free international science and scholarship.

There was, I came to feel, a very real need for this approach, in the United States no less than in Great Britain, for unfortunately the works of the Nazi writers who provide the theoretical justification for the attack on science have never been translated, are difficult to obtain either in

America or Great Britain, and hence are practically unknown in either country. Yet only by some acquaintance with the works of such men as Spann, Klages, and Blüher in philosophy; Marr, Jung, Haiser, Moeller-Brück, etc., in sociology; Brohmer in biology; Jaensch, Hommes, Krannhals and Schulze-Soelde in racialism; Rosenberg and Krieck in what can only be called Nazi "mythology"; Stapel and Freyer in ethics; and Leonard and Stark in the history of science—can one hope to appreciate the full iniquity of the power that has destroyed free science in Germany, laid waste the universities of Poland, now overshadows the centres of learning in the countries of western and northern Europe, and against which the British people alone now stand, backed by the people of the great sister nation of the United States of America.

In this approach, I analysed the sociological origin of Nazi-Fascism, growing up as it did in the "fear field" between the socialist East and the democratic capitalist West, bent on world domination, and bound by its own necessity to a more efficient militarism than any hitherto known. Hence its attack upon international science took the various familiar forms.

(1) Anti-intellectualism, for when the ideals of a State can no longer be commended to the people in rational terms, irrational emotionalism must be fostered, and all scientific scepticism combated.

(2) Racialism, the greatest scientific fraud yet perpetrated on humanity, for the units of the military machine must be convinced that they belong to a "master-race" fated to dominate adjacent "subject-races". This has involved not only the flouting of all scientific anthropology, but also the "principle of racial conditioning of scientific knowledge" according to which no valid scientific results have ever been produced except by "Aryans" and "the concept that twice two make four is somehow differently tinged in the minds of a German, a Frenchman, a Negro or a Jew" (Hommes).

(3) *Wehrwissenschaft*, the concentration of support for science only on destructive applications, and the withdrawal of funds, effort, and men from pure science—a process that has reduced Germany from a first-class scientific country to a third-class one in seven years.

(4) The leadership principle, contrary to all that we have come to know of human nature through twenty centuries, and based on the fallacy of "biologism", the idea that human society can be treated as if it were of the same order of complexity and organization as animal associations.

The reception accorded to these discussions in the United States was extraordinarily friendly and enthusiastic. It was noticeable, however, (especially where the audience was composed mainly of older people) that there was sometimes a preference for discussing the situation of science in Great Britain, and how help could best be given, rather than the nature of the threat to European science on the Continent. This may indicate a tendency in some Americans to throw Nazi-Facism together with all the European tyrannies that Americans have been traditionally accustomed to hate, and this in turn might lead to the conclusion that in the long run it would be better for America to accept the *fait accompli* of a fully Nazified Europe and 'do business' with the governors of it, just as Americans have had to do in the past with many regimes of which they personally disapproved.

In spite of the fact that Mr. Roosevelt, whose firm foreign policy has been so important, has been re-elected, this tendency will probably develop, and it is being fostered by the Vichy French and other "spurious continental nationals" in America who are being used as stalking-horses by the Nazis. I did what I could to counter it by pointing to the havoc made by Nazis in international science and the impossibility of American democracy being able to live for long in a world the rest of which, including probably South America, was dominated by victorious Nazism.

At the same time there are certain points of the policies of British Governments up to the present at which American criticism is often directed. There is a strong minority in the United States who intensely deplore the failure of Britain to come to a thorough understanding with the U.S.S.R. Furthermore, there is a general feeling among Americans that in spite of all that may be said to the contrary, justice is not being done to India. It is feared, moreover, that the conventional classical training of many of those in public positions responsible for the conduct of the present War does not fit them for appreciating and using to the full the capacities of British scientific workers both for offensive and defensive action.

One point which must be referred to here is the remarkable and charming enthusiasm with which Americans welcome English visitors to their campuses at times like this. As time went on, I came across an unexpectedly strong feeling that there might be a certain number of older scholars, perhaps rather in the humanities and some branches of mathematics than in the sciences (where some relation to the war effort is likely everywhere), having little or no teaching duties owing to the War, who might be evacuated to American campuses, on indefinite leave of absence from their own Universities, and on their normal emoluments, there to pursue their researches in peace and quiet, and to act with British Government backing, as goodwill representatives from the Anglo-Saxon civilization of the Old World to that of the New. Prof. H. S. Taylor and Prof. O. Veblen of Princeton were especially prominent in proposing some such scheme. It remains to be seen whether anything will come of it. At the same time it should also be mentioned that American sympathy for the British cause is so great that if at some later date owing to destruction of laboratories by bombing it should be necessary to evacuate a good many British men of science to the New World, nothing could exceed the welcome they would receive from their American colleagues.

It will be generally admitted that the part which the United States is playing and will play in this War will (with that of the U.S.S.R.) go far in deciding the future of the world. Only by drawing on American arms production can we hope to put an end to the activities of Europe's newest and worst tyranny. Hence the extreme importance of Anglo-American relations. Unfortunately, it is not in accordance with the facts to assume that the enemy is not extremely active in putting his case, such as it is, in the United States. Although Nazism is genuinely unpopular there, there are many arguments of a fifth-column nature which are sedulously put about by Nazi agents (for example, that the Union of Europe is being achieved, and that the people are glad to have it so, if Britain would only cease her opposition) and British activity in countering this and presenting the true facts in America is on a ridiculously small scale. No one more than the Americans themselves would like to see a very great extension of our information services in the United States. But whatever is to be done should be done quickly, for the enemy never lets grass grow under his feet, and now that the isolationist-supported presidential candidate has been defeated, the enemy's efforts will be redoubled.

It would not be too much to say that upon Anglo-American, no less than upon Anglo-Soviet, relations hangs the outcome of the present conflict ; and Anglo-American contacts of scientific men, with their closely joined traditions, and their common detestation of the Nazi menace to international science, are calculated most happily to improve them.

OBITUARIES

Dr. F. W. Edwards, F.R.S.

FREDERICK WALLACE EDWARDS was born at Fletton, Peterborough, on November 28, 1888. His unexpected death, following a comparatively short illness, occurred in November 15.

From the Cambridge County School, where Edwards had already displayed a marked attraction to both botany and zoology, he entered Christ's College, Cambridge, in 1906, and commenced reading for the Natural Science Tripos under Sir Arthur (then Dr.) Shipley. He graduated in 1909, was admitted the degrees of M.A. in 1925 and Sc.D. in 1931. For many years a fellow of the Royal Entomological Society of London and an honorary or corresponding member of numerous scientific bodies, he was elected a fellow of the Royal Society in 1938.

In 1910, Edwards joined the staff of the Department of Zoology in the British Museum, being appointed Assistant in the Entomological Section, thus realizing an ambition he had cherished from childhood ; in 1937 he was promoted to be a deputy keeper of the Department of Entomology which had been created in the interval. He was given charge of the mosquitoes, the crane-flies, and the British collection. His industry and ability quickly won him a larger share of responsibility, and he extended his care to the whole of the Nematocerous Diptera. The selection of Edwards for this post was a peculiarly fortunate one. It was intended to carry on and extend the work of F. V. Theobald, the last volume of whose Catalogue of Mosquitoes (inspired by the work of Manson and Ross and the needs of tropical medicine) had appeared only a few months earlier, and it succeeded beyond all expectations.

Almost immediately Edwards flung himself wholeheartedly into the task, and from the very first his papers showed a mastery of his subject and a critical faculty scarcely to be expected so soon ; within two years he had already published ten valuable contributions on the systematics of the Culicidæ of Africa, the Oriental region and Great Britain, including much needed synopses of all the known African species and their larvæ. Inevitably the African fauna made the most insistent calls upon his attention, and a long series of papers published in the *Bulletin of Entomological Research* kept both entomological and medical men in that continent abreast of the taxonomy of the family, the whole subject being brought comprehensively up to date in the last volume of the "African Mosquitoes" (published by the Trustees of the British Museum (Natural History)) now in the press. It was Edwards' one anxiety when taken ill that this volume should be complete, and it will prove a fitting coping-stone to his labours in this sphere.

It would be wrong, however, to assume that Edwards confined himself in the main, or even at all, to this important family of Diptera. Though the acknowledged master of them, he sometimes confessed that he was rather tired of them and their 'importance' and preferred other groups less insistent in their claims but more attractive in their purely scientific appeal, such as the fungus-gnats (Mycetophilidæ), crane-flies (Tipulidæ), the Blepharoceridæ, the remarkable larvæ of which cling to stones in torrential streams, fossil Diptera and the British fauna as a whole. On all these groups and many others he published freely and indeed by the end of 1932 over 270 titles stood to his credit, represented by more than 3,000 pages of print. As a testimony to his industry it is perhaps worth mentioning that to provide some of the illustrations in these papers he himself prepared 1,800 drawings and 400 photographs in his spare time. Since then very many more have been added.

In the course of his work Edwards visited many museums on the Continent and in America, studying the collections of earlier dipterists whose descriptions were only to be elucidated by the critical examination of their material. In addition, however, he led two successful expeditions. The first, to Patagonia, Chile and the Argentine, was to some extent inspired by a desire to test Wegener's hypothesis concerning continental drift, by means of a comparative study of the dipterous fauna of that region with those of Australia and New Zealand. It led to a far-reaching account of the "Diptera of Patagonia and South Chile" which has already run to more than 2,000 pages and awaited only Edwards' summary and conclusions, now sadly lost to us. The second sprang from a desire to investigate the relationships existing between the faunas of the isolated high mountain groups of East Africa, and was concentrated mainly on Mount Ruwenzori. The first fruits of this equally successful expedition have already been published.

As a colleague both in the field and the Museum, Edwards was an inspiration, almost a source of amazement. His early years at the Museum, where he found himself working with a colleague temperamentally his antithesis and employing methods of a bygone generation, were succeeded by the testing trials to which his conscientious objections to warfare forced him. There was, however, never a word of complaint or hint of bitterness; instead, he devoted himself with ever-growing intensity to his work. The fruits of his labour it is quite beyond the scope of this brief notice to catalogue, nor are they all to be seen in his published writings. There can be few dipterists the world over, be they professionals or amateurs, who would not acknowledge him as a leader, and freely admit themselves in his debt as much for friendly help and advice as for the more formal help of his synopses, catalogues and revisions. Working on an order of insects in which novelties are a commonplace, it would have been easy for him to become a 'describing machine'; as it was, he described upwards of 2,000 new species, but always these descriptions were incidental to constructive taxonomic work on larger units of classification. Hence in practically every group of Nematocerous Diptera studied by Edwards it is to him that one turns for means of identification. This is particularly true of the British fauna, the known extent of which he increased by some 500 species, nearly all of his own collecting. His untimely death when at the zenith of his career and with every prospect of many years of increasing productiveness is for dipterists little short of a tragedy.

N. D. RILEY.

Dr. S. P. McCallum

THE many friends of Dr. S. P. McCallum, demonstrator in physics at the University of Oxford, have heard with much regret of his death on November 16.

Dr. McCallum was well known for his many activities. He was in the New Zealand Army that fought in the War of 1914–18, and in 1920 he came to Oxford as a Rhodes scholar. He had a distinguished undergraduate career and obtained a first class in the final honours examination in physics and afterwards a research degree. He was elected to a fellowship at New College in 1928 in recognition of his research work, and shortly after to a University demonstratorship in physics.

Dr. McCallum's scientific work on the conductivity of gases was done at the Electrical Laboratory, Oxford. The investigations he made of the coefficients of ionization of electrons in monatomic gases are of much importance in the theory of conductivity. His work on the effects of impurities in gases and the remarkable differences which he observed in the forms of luminous discharges in different gases are also of much interest.

Dr. McCallum excelled as a teacher, and the personal interest he took in his pupils was very much appreciated. He also assisted in the general work of the University. For many years he was Junior Bursar of New College, and last year he was a University proctor. He will be greatly missed, not only on account of his scientific work, but also on account of his general interest in College and University affairs.

WE regret to announce the following deaths:

Prof. Emile Argand, professor of geology, mineralogy and palæontology in the University of Neuchâtel, aged sixty-two.

Mr. C. V. Bennett, past president of the Institution of Gas Engineers, on November 18, aged fifty-three.

Dr. Wilhelm Haberling, professor of the history of medicine in the Düsseldorf Academy of Medicine, aged seventy.

Prof. F. H. Herrick, emeritus professor of zoology in the Western Reserve University, on September 11, aged eighty-one.

Dr. P. A. T. Levene, emeritus member of the Rockefeller Institute for Medical Research, on September 6, aged seventy-one.

Colonel T. S. Sinclair, formerly member of Parliament for Queen's University, Belfast, on November 25, aged eighty-one years.

NEWS AND VIEWS

The Royal Society: Election of Officers

At the anniversary meeting of the Royal Society held on November 30, the following officers and members of Council were elected: *President*, Sir Henry Dale, director of the National Institute for Medical Research; *Treasurer*, Prof. T. R. Merton, formerly professor of spectroscopy in the University of Oxford; *Secretaries*, Prof. A. V. Hill, Foulerton research professor, and Prof. A. C. G. Egerton, professor of chemical technology in the Imperial College of Science and Technology; *Foreign Secretary*, Sir Henry Tizard, rector of the Imperial College of Science and Technology; *Other members of Council*, Prof. P. M. S. Blackett, professor of physics in the University of Manchester; Prof. F. T. Brooks, professor of botany in the University of Cambridge; Dr. C. G. Darwin, director of the National Physical Laboratory; Dr. A. N. Drury, Huddersfield lecturer in special pathology, University of Cambridge; Dr. H. J. Gough, director of scientific research, Ministry of Supply; Prof. J. B. S. Haldane, Weldon professor of biometry in University College, London; Prof. I. M. Heilbron, professor of organic chemistry in the University of London (Imperial College); Prof. O. T. Jones, Woodwardian professor of geology in the University of Cambridge; Prof. R. T. Leiper, professor of helminthology in the University of London (London School of Hygiene and Tropical Medicine); Sir Thomas Middleton, chairman of the Agricultural Research Council; Prof. L. J. Mordell, Fielden professor of pure mathematics in the University of Manchester; Dr. C. F. A. Pantin, reader in invertebrate zoology in the University of Cambridge; Prof. H. S. Raper, Brackenbury professor of physiology in the University of Manchester; Prof. E. K. Rideal, professor of colloid science in the University of Cambridge; Dr. F. J. W. Roughton, University lecturer in physicochemical physiology in the University of Cambridge; Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University of Bristol.

Sir Henry Dale, C.B.E., Pres. R.S.

Sir Henry Dale, the new president of the Royal Society, is now director of the National Institute for Medical Research, and was formerly director of the Wellcome Physiological Research Laboratories (1904–14). For ten years (1925–35) he was one of the secretaries of the Royal Society. Over a long period, and with a succession of collaborators, he carried out important researches on the effects of histamine, an amine derived from ergot. For this work he was awarded a Royal Medal of the Society in 1924. This was extended to the isolation of histamine and acetyl-choline from animal tissues. Much of his later work was devoted to the discovery of the part played by these and other substances in a large number of important physiological and pathological processes. Closely related researches were being carried out in 1924 by Prof. Otto Loewi, then of the University of Graz, and Dale and Loewi were chosen to share the Nobel Prize for Medicine for 1936. In the following year, Sir Henry was awarded the Copley Medal of the Royal Society. As head of the National Institute for Medical Research, Sir Henry has directed a large number of investigations both within and outside his own special field. Numerous investigators from many countries have worked under his guidance.

Science and the National Welfare

Sir William Bragg's presidential address to the Royal Society, delivered at the anniversary meeting on November 30, did not include the customary survey of a branch of science with which the president himself is particularly familiar, and it can well be understood that such a survey at the present time might have been impolitic, as well as occupying time of the president which is fully occupied in other directions. But Sir William did give an impression of the increasing part which science is taking in promoting the national welfare (see p. 731 of this issue). After a brief reference to the men of science—pioneers of modern developments—who have died during the past year, he paid a glowing tribute to the younger men who have followed in their steps, maintaining worthily the tradition they have received by the acquisition of new knowledge, and in addition, grappling with its relation to society and to government. This newer aspect of scientific activity has been reflected also in the Royal Society. Whereas formerly many fellows of the Society have given their services to Government departments as required, and will no doubt do so in the future also, men of science now have, in the Hankey Committee, appointed a short while ago, a small body of leaders in direct touch with the Cabinet. The Society is represented on the Committee by its president and two principal secretaries, and has thereby accepted the responsibility of seeing that scientific developments and science itself are brought into the counsels of the nation; and Sir William continued, "We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within."

So Sir William Bragg laid down the office which he has held so worthily for the past five years. His presidency, which began in the years of peace, has extended over a period of growing anxiety for the progress of science, for the very existence of civilization itself, through the first year of a war between nations in which the whole of the forces of science are being mobilized by the combatants; and the appointment of the Hankey Committee is a recognition of this fact. But though it has required a world-wide catastrophe to raise science to the 'high places' of Government, Sir William has the satisfaction of knowing that the end for which he has striven so worthily has been achieved; it is the task of his successors in office to see that the full weight of scientific knowledge is brought to bear on all the manifold problems, both in peace and war, with which the rulers of Great Britain are confronted.

The Universities' Debt to Greece

THE Vice-Chancellor of the University of Cambridge presided at a public meeting held in the Regent House on November 23 to support the cause of Greece in the War. He was accompanied by the Greek Minister, the Provost of King's College (Mr. J. T. Sheppard), Sir Frederick Maurice (principal of Queen Mary College, London), the regius professor of Greek (Prof. D. S. Robertson), the Lord Lieutenant (Mr. C. R. W. Adeane) and the Mayor of Cambridge (Mr. E. O. Brown). The Vice-Chancellor (Mr. E. A. Benians, master of St. John's College) spoke of the sympathy and regard with which Greece is regarded in Great Britain, and particularly in the ancient universities of the country. "Wherever universities exist," he said, "they live and work in a light first kindled on the soil of Greece. To that source they trace the freedom of mind and spirit, without which they cannot fulfil their true functions."

H E. the Greek Minister also addressed the meeting, which passed a resolution, put by Mr. Sheppard, in the following terms: "We, Cambridge residents meeting under the chairmanship of our Vice-Chancellor, being conscious of the inestimable debt which every civilized nation owes to Greece, salute in her the source and pattern of our own free institutions, teacher of wisdom from of old, and faithful mother still of arts and sciences. Mindful also of the special ties which bind the University of Byron to the living memory of Greek heroes, we desire to place on record our profound and grateful admiration for the magnificent loyalty and courage with which the Greeks, who have so often withstood alien invaders, have dared again to take up the challenge in order to preserve for the Greek nation its own hard-won independence and to secure for the future of mankind that spiritual freedom which the world first learnt from Greece." The resolution concluded by asking the Greek Minister "to convey to friends in Greece, particularly to the members of the University of Athens, this token of our loyal friendship, of our faith in final victory and of our pride that the British Commonwealth of Nations strives and will strive with Greece for the same cause."

La France Libre

IN France, in common with the other German-occupied countries, there is no longer any freedom of expression, which is the essential fundamental of true art, literature and science, and all that contributed to the high place which that country held in the world of learning is now suppressed. A few of the French intellectuals have escaped and on them will depend the carrying on of the torch of French culture and learning. In order to do this a monthly journal has been founded entitled *La France Libre* in which the records of work and expression of free thought of these exiles from France will be conserved. By this means free French learning and free French thought will be co-ordinated and kept in being until that time when France is restored to her former freedom and prestige; and indeed it can only be through efforts such as this, and of other intellectual exiles from the oppressed countries, that the individual science and culture of the nations of Europe will survive.

The journal has the support of leading British men of science and of letters, headed by Sir William Bragg, past-president of the Royal Society, and expressions of sympathy have been received from members of universities and learned institutions all over the British Isles, Canada and the United States. The first number, which was published on November 15, contains an article on "La Communauté universelle de la Science" by Sir Richard Gregory and twelve others covering a wide sphere of interest. The journal is addressed to all Frenchmen and all those who love France, and is deserving of every support. It is not to contain propaganda. The price is 2*s*. a number or one guinea a year; all particulars may be obtained from *La France Libre*, 15 Queensberry Place, London, S.W.7.

Social Progress

IN a paper "What is Social Progress?" contributed to a symposium on social progress in the *Proceedings of the American Academy of Arts and Sciences* (**73**, 457–472; 1940) Prof. L. J. Henderson points out that terms like justice and social progress are useless for clear thinking because they have no accepted fairly clear meaning and can only be given an arbitrary definition at the cost of strong persistent emotional opposition. Social change, however, is a fact, but there is no logical or scientific test of the desirability of social changes except in relation to an end or purpose for which the test is utility. Prof. Henderson suggests that, in a given place, at a given time, for a given end, there may be an optimum rate of change of a given thing and some day this will be a subject ripe for careful study. The conditioned reflexes of men, as they are at any given time and in any given place, will be seldom negligible. More often than not, when the end is survival they will be again, as they have so often been, in the forms we name loyalty, the bonds of family, the sense of kinship, love of country and religious devotion, powerful social forces, and dangerously lacking when in default. Prof. Henderson suggests that among the innumerable effects of science on society, some must be harmful, according to any definition, now or hereafter, to many individuals and to some societies. Moreover, the effects of science upon society may well be only implicit functions of the state of science, but explicit functions of the rate of scientific development. The same scientific development proceeding rapidly may have one effect, proceeding slowly another quite different effect.

A second paper in the symposium, by Crane Brinton, points out that not only the word 'progress' but also almost every important word we try to use in performing logical operations on problems in the social sciences is subject to limitations, if less extreme, through lack of precise meaning. Mr. Brinton, reviewing the various meanings which progress has borne, refers first to the sense of improvement in a process or technique. Then there is the sense derived from theories of organic evolution developed in the last century or so, and finally the sense of moral or social progress. He points out that so long as the notion of progress is closely associated with our immediate notions of the difference between what is and what ought to be, progress will probably remain one of the most important ethical abstractions in common use. In a third paper, Prof. E. B. Wilson suggests that no scientific meaning can be attached to such a term as social progress until social science has advanced considerably further as a science, and social studies are unlikely to become scientific so long as the *mores* of our social scientists place brilliancy so far ahead of patience and generalities so far ahead of specification. We need a handbook of the social sciences which tells us what is true under what restrictive conditions. Until such coherent growth has begun and gained considerable momentum we shall probably not have the background on which to say what is social progress, and when social science has thus advanced we shall be talking rather in terms of various sorts of social progress and social retrogression.

The City and South London Railway

On November 11 the City and South London Railway celebrated its jubilee. The one outstanding criticism of this railway which could have been made was that the designers of the new line built for conditions then existing, and failed to take into account the changes that would occur in a few years' time. For example, the tunnel diameter was much too small, so were the first locomotives, the trains and the cars. The diameter had to be increased in 1922, and extensions were made for the railway between Stockwell and King William Street. It would appear that the railway made too timid a beginning. The *Electrical Times*, which also began its career about fifty years ago as *Lightning*, has referred to its earlier criticisms of the railway, and points out that perhaps its promoters dared not venture too far on what, after all, was an experiment without precedent; for the City and South London was the first electric tube railway ever built.

The new rolling stock has been designed to obtain the maximum amount of seating capacity consistent with comfort, and also allows a very much greater standing space than the old rolling stock. It has not been possible to introduce the new stock gradually, as part of the improvement of this railway is the moving of the conductor rail from its original position centrally between the running rails to the standard position laid down by the Ministry of Transport, namely, 16 in. outside the running rail; 6,445 yd. of new conductor rail have been laid. In order to reduce noise to a minimum, the running rails have been welded into 315-ft. lengths, involving 544 welded joints. Noise-absorbing shields are also being experimented with. These shields are fitted between the lower portion of the coaches and the tunnel walls. The City and South London is London's shortest tube railway. It is only 1 mile 46 chains long, and forms part of the quickest route from the heavily populated south-western suburbs to the very heart of the City. The journey only takes five minutes. The line was opened in August 1898, and carries an average of 30,000 passengers daily, most of them during the business rush hours. Nearly 40,000 yards of cables and wires have been laid in the course of the improvements.

Fitting Schoolboys for the World of Work

"Guidance Programs for Rural High Schools", by Mr. Paul Chapman (Washington, D.C. 10 cents), is a bulletin belonging to the 'Occupational and Guidance Service' established by the U.S. Office of Education in response to a widespread demand. It has been revised after critical comment on a limited edition and shows once more the great elaboration of American education. High schools in rural districts have comparatively few pupils; but, as the foreword points out, they are important for society as a whole, because "no large city in our Nation is producing enough children to maintain its population". Local conditions impose differences of training and the two models noticed in detail from New York State are much larger than the average rural school. But one of them is described as "basically agricultural" and both can supply selections of things worth doing. All schools of the sort can go in for "occupational information, the personal inventory, counselling, exploration, use of training facilities, placement, and follow-up". This last word means close attention to pupils after they have left school.

To keep all these activities going lays a heavy burden on teachers. At Nyack School "counselors" have a great deal to do. They interview employers and make a monthly report. Personal data are supplied concerning pupils seeking work; former students have a two-page questionnaire sent to them; and their employers are expected to say how they are getting on. It is evident that this wide vigilance must produce good results and reduce the number of misfits who are "everything by starts, and nothing long". If all teachers did anything like as much, they might steady those restless adolescents who do little good for themselves or anybody else and often end on the dole. The programmes offered go right to the root of unemployment, but they demand a good deal of time and patience.

Ferns of Wales

Interest in the British native flora and in the study of botany in general is so admirably stimulated and encouraged by the excellent series of exhibits in the National Museum of Wales that the descriptive handbook of Welsh ferns by Mr. H. A. Hyde, keeper of botany, and Mr. A. E. Wade, assistant in the Department, is assured of a wide welcome (Welsh Ferns: a Descriptive Handbook. By H. A. Hyde and A. E. Wade. Pp. x+132+11 plates. Cardiff:

National Museum of Wales and the Press Board of the University of Wales, 1940. 5*s*.). Like its two predecessors dealing with the botany of Wales, published by the Museum, it is a most useful volume, and both text and illustrations leave little to be desired. The introduction conveys all that the student needs to understand the fern's life-history, and in the more detailed descriptive portion the keys and descriptions, aided by the clear text figures skilfully drawn by Miss E. A. Jenkins, should enable anyone to identify and discover all there is of interest in our native ferns. Now that so many name changes have taken place, one would have welcomed the inclusion of some of the old names—now synonyms—with which older botanists are more familiar.

Utilization of Sun Power

GENERATION of electrical energy direct from the sun's rays has been feasible for many years, but in most cases the price is quite prohibitive. Up to a few years ago, such installations took up so much space and required such a high expenditure per horse-power on apparatus that projects suggested were not inviting. Most engineers took this view and regarded them as only of academic interest. Recent advances in the treatment of aluminium, in vacuum jacketing, in flash boilers and in mechanism for following the sun on its daily course have put a different aspect on the problem of solar steam-raising plant. Dr. C. G. Abbot, secretary of the Smithsonian Institution, Washington, D.C., who is well known for his solar investigations, now states in the course of an article covering some six pages (*J. Amer. Inst. Elect. Eng.*) that power from the sun can be obtained at 0·5 cent per h.p., which is the pre-War equivalent of one farthing. He estimates that at this price such schemes can give a good return on investment. Even if we apply the corrective factor which is usually necessary in estimates by enthusiasts and raise the farthing to ½d. or ¾*d*., sun-power is obviously becoming a business for hot climates, and developments are worth watching.

Health of New Zealand

ACCORDING to the Director-General of Health, in 1939 the death-rate of New Zealand with a population of a little more than 1,500,000 (including 80,000 Maoris) was 9·20 per 1,000 population (excluding the Maoris) and the infantile mortality (with the same exclusion) 31·14 per 1,000 live births. The birth-rate was 18·73 per 1,000 of population. Heart disease was the principal cause of death, and cancer, from which there were 1,815 deaths, came next. The incidence of infectious diseases was low, but their notification among the Maoris had increased. The nutrition of the majority of school children was satisfactory, but there was still some evidence of subnormal nutrition. Maternal deaths due to pregnancy or childbirth other than deaths from septic abortion numbered 85, a death-rate of 2·95 per 1,000 births, as compared with 2·80 for England and Wales in 1938. There were 147 cases of puerperal sepsis notified. The rise in the number of deaths due to this cause has been attributed to the wrongful use of sulphonamides resulting in a granulocytosis. The maternal mortality among the Maori women, a large number of whom are still delivered by native methods, was 4·13 as compared with 5·41 the previous year.

Health on Gibraltar

THE report for 1939 of Major R. A. Mansell, the medical officer of health of Gibraltar, of which a summary appears in the *British Medical Journal* of November 2, states that among the civilian population the birth-rate was 20·85 per 1,000 and the death-rate 14·25, which were both larger than in most English towns. The infantile mortality, which has been rising steadily in recent years in association with gross overcrowding, was last year 79·36 per 1,000 births and was the highest since 1928. On the other hand, Gibraltar has been singularly free from epidemic disease. During the year there were only 93 cases of notifiable infectious diseases, the lowest number for half a century, and more than a third of these were chicken-pox. There were ten deaths from pulmonary tuberculosis, the prevalence of which is causing the medical officer some disquiet.

Bibliography of Seismology

THE *Bibliography of Seismology*, covering ninety-eight items for the period April, May, June 1940, published by the Dominion Observatory at Ottawa and compiled by Ernest A. Hodgson, has just been received. It is an invaluable reference work and contains items from most countries concerning studies of individual earthquakes, seismological apparatus, seismic prospecting, rock bursts, travel-time tables, tunamis, and many kindred subjects. A list of six patents for apparatus chiefly in connexion with seismic surveying is listed. All are American patents. References are given to seismological and geophysical publications in the *Proceedings of the Royal Society*, in NATURE, in the *Geophysical Supplement of the Royal Astronomical Society* and other British periodicals.

Announcements

IT was announced in the *London Gazette* of December 3 that the King has approved the award of the George Cross to Dr. A. D. Merriman, part-time experimental officer in the Directorate of Scientific Research, Ministry of Supply, "for conspicuous bravery in connexion with bomb disposal."

BY German decree the University of Leyden and the Technical High School at Delft have been closed owing to the "generally anti-German attitude of the undergraduates, and sabotage of the anti-Jewish measures". All professors of the Faculty of Laws of the University of Utrecht have been sent to concentration camps in Germany, while several professors of the Catholic University at Nijmegen, and of the Commercial High School at Rotterdam, have been arrested because of their loyalty to the House of Orange and openly admitted preference for a democratic system of government. A number of students at all these institutions have been arrested, fined, or sent to concentration camps.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Absorption of Cosmic Ray Protons in Lead

AT the suggestion of Prof. P. M. S. Blackett, we have recently investigated the absorption of cosmic ray protons in lead with a cloud chamber situated in a laboratory with a light roof.

The experimental arrangement is shown schematically in Fig. 1. Counters *A*, *B*, *C*, connected in coincidence, are placed above and below the vertical cloud chamber, *Ch*. Below *C* is a lead plate (*s*) 2 cm. thick, and a bank of counters *D* connected in parallel. *ABC* and *D* are connected to an anticoincidence set[1]. No particles which can penetrate *s* (that is, no protons of energy greater than $1 \cdot 5 \times 10^8$ ev. or electrons of energy greater than 3×10^7 ev.), are recorded. Protons are therefore observed only in the energy range in which they can be distinguished clearly from electrons and mesons. Photographs and counts were taken alternately with (*a*) no lead ($\Sigma = 0$). and (*b*) 20 cm. lead ($\Sigma = 20$ cm.) above the apparatus. The results are given in the accompanying table. Only one proton, illustrated in Fig. 2, is found in 370 hours for $\Sigma = 20$ cm., whereas 8–12 protons are found in the same time for $\Sigma = 0$. The two figures quoted for $\Sigma = 0$ mean that of twelve tracks thought to be due to protons, eight are unambiguous. The figures for $\Sigma = 0$ compare favourably with those found by other workers[2].

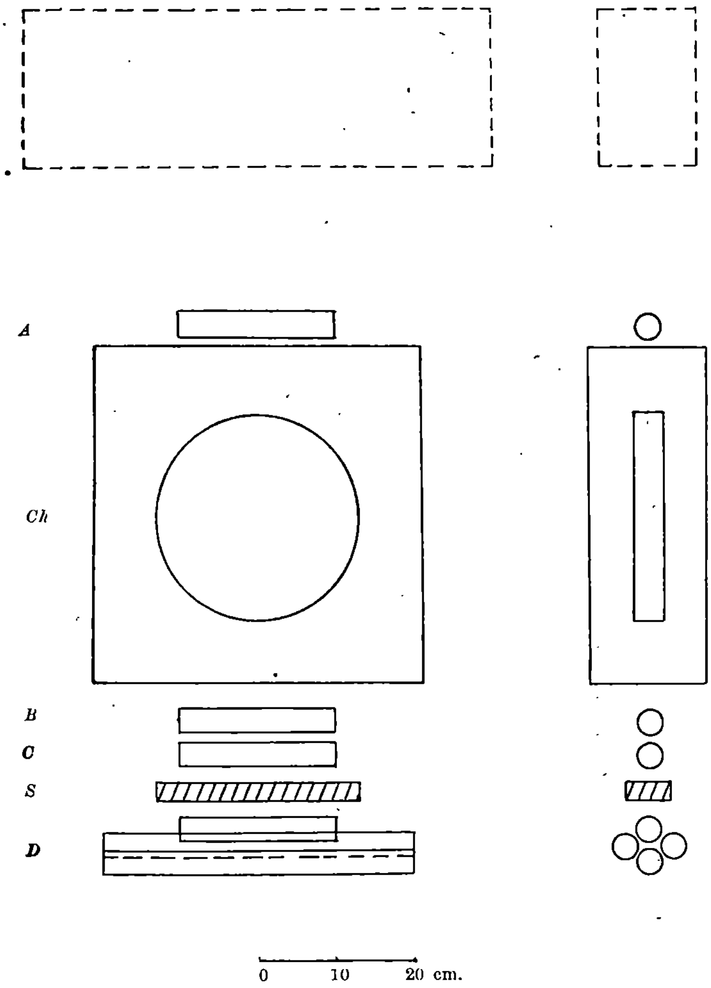


Fig. 1.

The interpretation of the results depends partly on the assumed place of origin of the protons and partly on the form of their spectrum.

(1) If the protons observed in the cloud chamber come from a beam incident on the 'top' of the atmosphere, we compare in the experiment protons which initially have ranges (*a*) of 90–92 cm. lead, and (*b*) 110–112 cm. lead. Protons of this range have energies of the order of 2×10^9 ev. By analogy with the meson spectrum, one would expect the proton spectrum in this region to be fairly uniform, so that one would expect almost equal numbers of rays in both range groups. The fact that far fewer are observed with $\Sigma = 20$ cm. would mean that cosmic ray protons are absorbed strongly in lead.

(2) On the other hand, the results can equally well be explained if it is assumed (*a*) that the observed protons come from a group of protons of relatively short range; for example, less than 10 cm. lead, and (*b*) *either* more protons are found in air than in lead *or* the radiation producing the protons is filtered out by the lead (Σ). This latter would be true if the protons were produced by photon disintegration.

Some results of Anderson[2] are more in agreement with hypotheses (2) rather than (1). It appears, then, that the protons do not come from a beam incident on the 'top' of the atmosphere.

On one other point we would like to comment briefly. Both counts and photographs show that far fewer electrons are observed below 20 cm. lead than in air. These electrons are probably made up of (*a*) meson disintegration electrons, (*b*) meson knock-on

Σ (cm.)	Arrangement	Counts			Photographs					
								Analysis		
		Number	Time (hours)	Rate (c.p.h.)	Total number	Time (hours)	Rate (c.p.h.)	Singles	Showers	Blanks
0	ABCD	5257	802·7	6·6	2535	372·3	6·8	1622	219	694
	ABC	2457	85·8	28·7						
20	ABCD	1648	588·0	2·8	1042	369·2	2·8	589	103	347
	ABC	1094	52·0	21·1						

electrons, and (*c*) electrons from large cascade showers. The effect of lead will be to decrease the contribution of (*a*), since disintegration electrons are of short range ($\sim$2 cm. lead), and probably to decrease the contribution of (*b*) since, as Dr. L. Jánossy has pointed out to us, the meson will accompany the knock-on electron and thus prevent the electron from being recorded. Even if the contribution of (*c*) is the same, the total effect of the lead will be to reduce the number of electrons.

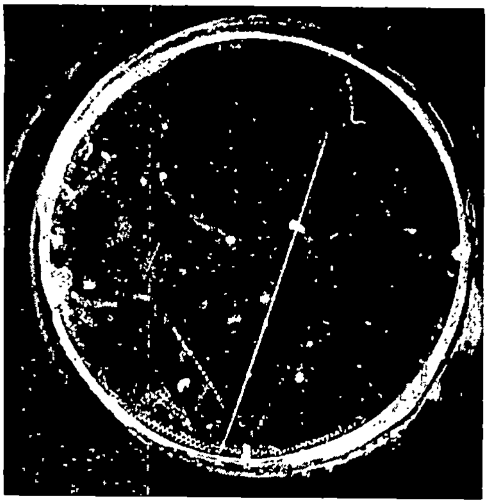


Fig. 2.

G. D. ROCHESTER.
M. BOUND.

Physical Laboratories,
University,
Manchester.
Nov. 15.

---

[1] Circuit unpublished. We are indebted to Dr. B. Rossi for the use of the anti-coincidence set.

[2] Anderson, C., *Phys. Rev.*, **50**, 263 (1936); Brode, R. B., Macpherson, H. G., and Starr, M. A., *Phys. Rev.*, **50**, 581 (1936).

[3] *vide* Anderson, *ibid.*, Heitler, W., Powell, C. F., and Fertel, G. E. E., NATURE, **144**, 116 (1939).

Occurrence of Vanadium and Molybdenum in Clays

THE occurrence of vanadium in clays has been known for some time, the amounts varying from a chemical trace to about 14 per cent[1,2,4]. Mellor devised a method for determining vanadium in the presence of titanium, but the surest test is a spectrographic one. Generally the percentage is less than 1 per cent and it is not known in what form it occurs. Callister[1] in Australia noted that vanadium compounds in kaolins are not water-soluble until the clay has been heated to temperatures of above a 1,000° C. I have found similar properties in South African clays. Many fire and building bricks made from clays of Karroo age exhibit a greenish-yellow or canary-yellow efflorescence, after weathering. The efflorescence is readily soluble in hot water. This efflorescence contains vanadium and molybdenum. Molybdenum is a much rarer constituent and is not easily detected in clays, by ordinary methods. In fact the only method appears to be, to heat large lumps of the material to temperatures of about 1,000° C. and then to extract with hot water and crystallize the salts in solution.

A partial analysis of the water soluble material from an under-fired firebrick gave:

MoO_3	0·08 per cent
SO_3	1·01 per cent
CaO	0·28 per cent

the sample being dried at 110° C. A qualitative spectrographic analysis showed the presence of abundant sodium and vanadium and little else. Molybdenum was confirmed and iron was found in small quantities. It is noteworthy that while vanadium is easily detectable by spectrographic means, in the raw clay, molybdenum does not appear in the spectrogram. The concentration as described above must be done first.

It is possible that the vanadium and molybdenum compounds are contained in the clay complex and are not rendered soluble until these minerals are broken up. The crystals obtained from the calcination and water extraction treatment are birefringent and yellow-green in colour. They appeared to be perfectly homogeneous under the microscope.

The presence of molybdenum in mine, mineral and surface waters has been recorded by Novokhatsky and Kalinin[3], and they suggest its adsorption by freshly precipitated iron and manganese hydroxides.

Mr. Berkowitz directed my attention to this efflorescence, and his work, which preceded mine, had similar results.

V. L. BOSAZZA.

University of Witwatersrand,
Johannesburg.
Oct. 13.

---

[1] Callister, R. C., Bull. 27, Inst. Sci. Ind. Australia (1924).

[2] Palmer, L. A., *J. Amer. Ceram. Soc.*, **12**, 37–47.

[3] Novokhatsky, I. P., and Kalinin, S. K., *C.R. Acad. Sci. U.S.S.R.*, **24**, 278 (1939).

[4] Bourry, J., "A Treatise on the Ceramic Industry" (1926).

Hydration of Carbon Dioxide and its Influence on Germicidal Activity of Hypochlorite Aerosols

We are interested in the suggestion put forward by E. O. Powell in his recent communication[1], in which he stated that the effective bactericidal life of hypochlorite aerosols is dependent on "the velocity of changes occurring between the collision of carbon dioxide molecules in the air with droplets of the aerosol and the appearance of the corresponding H ions". The hydration process, it was suggested, might be slow compared with the former, thus becoming the rate-controlling factor in the bactericidal action of the aerosol.

When using an aerosol produced from a solution containing 1 per cent NaOCl, 16·5 per cent NaCl and 0·05 per cent Na_2CO_3, we were unable to detect any difference in the killing rate or the mean percentage kill (over a 30 min. period) of aerially dispersed *E. coli*; whether the tests were carried out in normal atmospheres, those to which 1 per cent carbon dioxide had been added, or from which the carbon dioxide had been removed[2]. (Our conditions may not have been entirely free from carbon dioxide, but the concentration must have been very much reduced.)

If the hydration of carbon dioxide is a slow process and the liberation of free HOCl dependent on this alone, then it might be expected that the hypochlorite aerosol would show a slow initial rate of kill which accelerates with time. Our experiments have shown that a good kill is obtained in the first five minutes and that the subsequent rate becomes slower; this is not necessarily in opposition to Powell's mechanism, which might take place within five minutes and have the effect of maintaining a fairly constant concentration of HOCl in the droplet owing to loss of the acid by evaporation. Evaporation of the water will, of course, reduce the amount of carbon dioxide absorbed by the droplet.

We have shown also that hypochlorite aerosols become decreasingly effective in acid, neutral and alkaline solution, although the neutral solution gave the best all-round results when the persistence of the action is taken into account. It was also found that HOCl as vapour is relatively ineffective. The action appears to depend upon the presence of free HOCl in the droplet, but not on either ClO^- or H^+ ions alone, since alkaline NaOCl or weakly acid solutions (free from NaOCl) are much less effective.

The addition of glycerol to hypochlorite solutions for use as aerosols seems to be of doubtful utility; it reduces the bactericidal activity of the mist, but generally increases its persistence, the increase given being governed by the particle size of the droplets. We have attributed the effect of glycerol to its effect upon the evaporation of water from the droplet. In bulk it was found that the presence of glycerol reduces the stability of hypochlorite solutions, especially if some acid is also present. The presence of a salt (for example, NaCl) has an effect somewhat similar to that of glycerol by retarding the evaporation of water from the droplet.

A. H. Baker.
S. R. Finn.

Portslade Research Laboratories,
South Street,
Portslade. Nov. 1.

---

[1] Powell, E. O., Nature, 146, 401 (1940).

[2] Baker, Finn and Twort, *J. Hyg.*, 40, 560–582 (1940).

Ionospheric Observations during the Solar Eclipse of October 1

During the total solar eclipse of October 1 ionospheric observations were made at three points in South Africa by the following three institutions: Cruft Laboratory, Harvard; Commonwealth Solar Observatory, Canberra; Bernard Price Institute for Geophysical Research, Johannesburg.

The results have revealed a marked ultra-violet light effect in the F_2 region. The maximum electron density in that region showed a decrease of about 20 per cent, reaching a minimum about 30 minutes after totality. There was no evidence for corpuscular effects. The behaviour of the E and F_1 regions was similar to what has been observed at previous eclipses.

J. A. Pierce (Cruft Laboratory).
A. J. Higgs (Commonwealth Solar Observatory).
E. C. Halliday (Bernard Price Institute).
Oct. 14.

Termination of Optic Fibres in the Lateral Geniculate Body

In a recent letter[1], Prof. Le Gros Clark directed attention to the evidence that crossed and uncrossed fibres of the optic tract each terminate in three alternating layers of cells in the lateral geniculate body in the monkey. Hitherto, however, this has been an inference based on the indirect evidence of transneuronal atrophy. It has now been finally established in this laboratory by the study of axonal and bouton degeneration, following section of one optic nerve. Seven days after this operation, the corresponding cell laminæ of the lateral geniculate body are filled with enlarged and grossly degenerating terminal boutons which are so conspicuous that they can readily be observed under low magnifications, and the affected laminæ thus contrast strongly with the normal laminæ.

P. Glees.

Department of Human Anatomy,
University of Oxford.

---

[1] Nature, 146, 558 (Oct. 26, 1940).

Molecular Fields of Force

My article on "Molecular Fields of Force"[1] contains a misrepresentation of Prof. J. E. Lennard-Jones's work on this subject, which I much regret and wish to correct. In referring to the degree of ambiguity in his molecular models inferred from gas data, I stated that it remains uncertain whether the distant field is attractive or repulsive; this applies only to the determinations from viscosity data (and then only in certain cases); but not to his main and more important determinations from the equation of state. It is on these that he has based his valuable *applications* of the force-data, to explain many physical properties of solids and liquids as well as vapours.

S. Chapman.

Imperial College of Science and Technology,
South Kensington,
London, S.W.7.
Nov. 25.

---

[1] Nature, 146, 607 (1940).

RESEARCH ITEMS

International Standards for Biological Assay

AN inquiry on the assay of gas gangrene antitoxin (perfringens) carried out under the auspices of the Department of Biological Standards of the State Serum Institute, Copenhagen (League of Nations. *Bulletin of the Health Organisation*, **8**, No. 6, 797–912 (1939). Biological Standardisation, iv), reached the following conclusions. Perfringens antitoxins show the same activity when assayed against different toxins, if the toxins contain one and the same predominant antigen. The hæmolysin content influences the assay when the ratio minimum lethal dose/minimum hæmolytic dose exceeds 100. Intravenous assays on mice give results corresponding to those obtained intracutaneously on guinea pigs when pure ζ or ζ,α toxins are used. There is a relation between the activities of a perfringens antitoxin determined *in vitro* (hæmolysis) and *in vivo* only if pure ζ toxins are used in both tests. A perfringens toxin suitable for estimating the ζ antibody content in perfringens antitoxins has been prepared in Copenhagen and is at the disposal of institutes. The international unit for gas gangrene antitoxin (Sardelli) is defined as 0·1334 mgm. of the dry stable Washington preparation. Contributions towards the international standard preparations for (1) the gonadotropic substance of pregnancy urine; (2) the gonadotropic substance of pregnant mares' serum and (3) the lectogenic (crop-gland stimulating) substance of the anterior pituitary gland have been assayed in a number of different laboratories and the results analysed by C. W. Emmens of the National Institute for Medical Research, Hampstead, London. The international units for these three substances are respectively 0·1, 0·25 and 0·1 mgm. of the international standard mixtures. Suggestions for the use of these standards in biological assays are given.

Production of *pertussis* Antitoxin

EXTRACTS of *Hæmophilus pertussis*—the causal bacterium of whooping-cough—are toxic; they kill guinea pigs when a suitable dose is injected into a vein, and they produce necrotic lesions when injected into the skin of a rabbit. Investigation by independent workers of the problem whether the toxin can give rise to an antitoxin has led to conflicting opinions, and thus a recent paper by D. G. Evans (*J. Path. and Bact.*, **51**, 49–58; 1940) is of interest, especially since he, in collaboration with H. B. Maitland, had previously failed to obtain positive results. Evans now finds that rabbits, when immunized subcutaneously with the toxin, give definite evidence of having acquired immunity to it and that, moreover, the serum of such rabbits is capable of neutralizing both the necrotic and the lethal action of the toxin. A toxic substance with similar properties is extractable from *H. parapertussis* and *Brucella bronchoseptica*, and it has been found that 'pertussis' antitoxin is able to neutralize each of these toxins, a result which confirms the view that the micro-organisms from which they are derived are closely related to *H. pertussis*. An antibacterial serum against *H. pertussis* can be prepared in experimental animals by inoculating them intravenously with the whole organism or extracts from it, but this form of therapy has not been entirely effective in the prophylaxis and treatment of whooping-cough; nor has the serum from convalescent patients proved its value. The author considers that an antitoxic serum of high potency should be given a trial as a preventive and remedial agent in this disease.

Sunspots and Insect Epidemics

THE probable existence of some regularity in the fluctuations of animal numbers has been investigated by several workers. The results of such inquiries have not always been convincing, mainly perhaps on account of the difficulty of collecting sufficient detailed accurate records. D. Stewart MacLagan (*Proc. Univ. Durham Phil. Soc.*, **10**, 175–199; 1940) has collected data relative to severe insect outbreaks in Britain. A historical study during the past hundred years of outbreaks of such insects as flea-beetles, cutworms, leather-jackets, antler moth and diamond back moth has been made. On epidemiological grounds it is claimed that the frequency of outbreaks of the species just enumerated is correlated with the periodicity of sunspots. The years of maximum frequency are nearly synchronous with epochs of sunspot maxima. The connexion between sunspots and outbreaks is considered to be climatic; the favouring circumstances it is claimed are probably increased humidity and more intense ultra-violet radiation. The article concludes with a bibliography of seventy papers.

British Pyrenomycetes

Messrs. G. R. Bisby and E. W. Mason have performed a very considerable service to British mycology in compiling a "List of Pyrenomycetes recorded for Britain" (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 127–243; 1940). Taxonomy of all the Ascomycetes is still at a very low level, and any contribution is valuable. The present paper is more than the mere list implied by its title: it is a systematic evaluation of the Pyrenomycetes, and should pave the way for more detailed work upon the group, so urgently needed at present. The classification of Saccardo has usually been followed, and accordingly the Laboulbeniales, Gymnoascales and Perisporiales take their place along with the more obvious Pyrenomycetes. Detailed references are given, and an index to genera and species makes for easy consultation. It is greatly to be hoped that the superstructure of specific descriptions will follow this taxonomic foundation.

Triploid Sugar Beet

H. Peto and J. W. Boyes (*Canad. J. Res.*, **18**, 273–282; 1940) have shown that triploid sugar beet resulting from the cross $4x \times 2x$ differs considerably in sugar content from diploid beets. The root weights of triploid beets exceeded those of diploids by 12·2 per cent, in sugar content by 14·9 per cent and in dry top weights by 17·8 per cent. The decrease in sugar percentage for each 100 gm. increase in weight was 0·34 per cent for the diploids and 0·17 per cent for the triploids. The economic possibilities of triploid sugar beet appear promising.

Temperature Differences in Lakes

In "Temperature Measurements in Vänern and Götaälv", Angström and Jacobson (*Med. fran. Stat. Met. Hydro. Anst.*, **7**, No. 6; 1940) describe the work done at the instance of the Swedish Royal Board of Waterfalls through a commission appointed in 1929 for investigating certain problems of ice formation in connexion with the regulation of Lake Vänern. The work consisted of a study of the variations of vertical temperature gradient in the course of the seasons and the influence thereon of wind; the measurement of the temperature gradient extended from the vast and not very deep lake itself down to the mouth of the Göte River, where the salt water of the Skagerrack often flows as a bottom current in the reverse direction to that of the overlying fresh water. It was only in the latter region of the river that large gradients were found, with temperature differences between the bottom and the surface of more than 1° C., while in the lake the largest gradients were found only in the summer, late July providing differences of the order of 10° C. between the bottom and the surface where the depth is 35 metres. In contrast to deeper lakes, where the minimum temperature of the deeper layers at the time of ice-formation is often 4° C., the minimum in Vänern is then very nearly 0° C. at all depths. The observations explained the remarkable fact previously observed, that after the lake has been frozen over and covered with deep snow the temperature of the river often rises, so that the river becomes clear of ice during the later parts of periods of great cold. This is clearly due to the checking of outward radiation by the ice and snow over the lake, which permits heat from the ground beneath the lake to cause the temperature of the water to rise. This heating from below was the cause of occasional differences of more than 2° C. between the bottom and surface layers of the lake in winter, to be found only when the ice cover is thick. This publication concludes with an extensive bibliography of the subject covering the period 1900–32.

Thiophosphoryl Chlorofluorides

Thiophosphoryl fluoride, PSF_3, is a colourless spontaneously inflammable gas, discovered by Thorpe and Rodger in 1888 and obtained by heating phosphorus sulphide and lead fluoride. H. S. Booth and M. C. Cassidy (*J. Amer. Chem. Soc.*, **62**, 2369; 1940) have now prepared the two chlorofluorides $PSFCl_2$ (b.p. 64·7°) and PSF_2Cl (b.p. 6·3°) by the action of antimony trifluoride on thiophosphoryl chloride, $PSCl_3$, in presence of antimony pentachloride as a catalyst. Thiophosphoryl fluoride is also formed. PSF_2Cl, like PSF_3, is spontaneously explosive in certain concentrations in air. Thiophosphoryl chloride exists in two solid forms, freezing at −40·8° and −36·2°.

Convective Equilibrium and Solar Limb Darkening

A. D. Thackeray has published a paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940) in which he shows the consequences of assuming convective equilibrium in the solar atmosphere when k, the mass-absorption coefficient, varies as p. The result of the analysis shows that both the darkening to the limb and also the distribution of energy in the spectra of disk and spot can be represented by the assumption of radiative equilibrium, or equally well by the assumption of convective equilibrium. In the latter case, however, it is necessary to assume that $k \propto p$ and also that γ is 4/3. These conditions may be realized at a certain level of the reversing layer or photosphere; but it must be admitted that they may not be true for the higher layers which affect the limb observations. In addition, there is no particular reason for adopting 4/3 as the value of γ, which represents the lower limit for a whole star. It is suggested that it would be interesting to repeat the calculations for other values of γ. An important conclusion on the equilibrium of sunspots is worthy of notice. Minnaert and Wanders made use of Milne's adiabatic hypothesis and applied two tests—the variation of the ratio spot/disk (1) from centre to limb, and then (2) in different wave-lengths. They concluded that neither of these tests was satisfied by the assumption of convective equilibrium in spots, but that both were satisfied by the assumption of radiative equilibrium. Minnaert and Wanders assumed the relation $k \propto p/T^{3/2}$, but on the assumption of convective equilibrium used by Thackeray he found that the facts could be equally well explained by assuming that spot and disk are both in convective equilibrium, or alternatively, that they are both in radiative equilibrium. Observations did not support the hypothesis that wave-length variations result from a convective spot and radiative disk, or from a radiative spot and convective disk.

Spectrum of Bright Chromospheric Eruptions

It is well known that bright chromospheric eruptions on the sun produce definite effects on the atmosphere of the earth. From the nature of the effects it is inferred that the solar influence is transmitted by ultra-violet light and that the ultra-violet intensity in the eruption is of the order of a thousand times that normally emitted from the sun's surface. As it is impossible to photograph the short-wave radiation which is suspected of causing the ionospheric disturbance, owing to the earth's atmosphere, its nature must be a matter of conjecture. C. W. Allen, assuming that such great changes in ultra-violet spectrum would imply some corresponding effects in the spectral regions that can be seen and photographed, has described the results of his investigations on eruption spectra (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The observations were made with the 3-prism spectrograph of the Commonwealth Solar Observatory in conjunction with the sun telescope. The eruptions were set on the slit to give the brightest emission in $H\alpha$ or $H\beta$, and 116 emission lines were detected and tabulated in various discontinuous regions of the spectrum from 3922 A. to 6700 A. On comparing the intensities of the eruption lines with those of the flash spectrum, it was discovered that all Fe lines and all low *E.P.* Fe lines are strongly enhanced in eruptions. The enhancement of the former is also detected in metallic prominences and 'hot spots' (this name has been given by Cillié and Menzel to regions of the flash spectrum which have shown signs of unusual excitation), but this does not occur with the low *E.P.* Fe lines. It is a matter of some interest that in long-period variables of classes Me and Se several low-level Fe lines are emitted, while bright Fe^+ lines are also present. It is possible to explain the small variations detected in the intensities of Fraunhofer lines from areas in eruption if the excitation temperature of the reversing layer is increased by about 100° K.

MEDAL AWARDS OF THE ROYAL SOCIETY*

COPLEY MEDAL

THE COPLEY MEDAL has been awarded to Prof. PAUL LANGEVIN.

Prof. Langevin was one of the band of young pioneers who, in the closing years of the last century, were engaged in exploring the field which had been opened up by J. J. Thomson's discovery of the electron. He spent a year (1897–98) at the Cavendish Laboratory, and his Paris Dr. ès Sc. thesis (1902) is dedicated to J. J. Thomson. The thesis, a notable one, was entitled "Recherches sur les Gaz Ionisés". It dealt mainly with the recombination and mobilities of ions, their coefficients and the relations between them. It is a standard work on this subject. In it he also devised and applied new and elegant methods of measuring these quantities which were an advance on all their predecessors and have not since been improved upon to any appreciable extent. Related to this, and coming later, were important contributions to the theory of the diffusion of gaseous ions and its relation to ionic mobilities.

Langevin's greatest achievement is the foundation of the electron theory of magnetism. The theories of paramagnetism and of diamagnetism are still very much as he made them and left them more than thirty years ago.

There are few branches of contemporary physics which he has not illuminated and improved by his writings, and his work generally has the qualities of breadth, clearness, elegance and completeness which stamp the master.

He has had a great international influence. He has been a prominent figure at all the meetings of the conferences arranged by the Institut International de Physique Solvay since they started in 1911. On the death of Lorentz he was chosen to succeed him as president of the above Institut.

He was awarded the Hughes Medal in 1915 and elected a Foreign Member of the Society in 1928.

[See NATURE of November '30, p. 715.]

RUMFORD MEDAL

The RUMFORD MEDAL has been awarded to Prof. KARL MANNE GEORG SIEGBAHN.

Prof. Siegbahn, member of an old Swedish family, is, in the field of X-rays, what Rowland was in the field of ordinary optics sixty years ago. He has introduced high precision into X-ray measurements. For example, the most accurate wave-length measurements in 1913 were those of Moseley, with an accuracy of about 1 per cent. By a brilliant succession of improvements in methods, design, inventions and technique, Siegbahn by 1924 had improved this to 0·001 per cent—a factor of 1,000.

Siegbahn is not only a great physicist, he is also a great engineer. He has made inventions and improvements in almost every useful type of apparatus connected with X-ray measurements, pumps, gratings, X-ray tubes, ruling machines, etc.

Among his many achievements are the determination of the structure of the *L* series of X-ray spectra, the discovery of the anomalous dispersion of X-rays (with Hjalmar), the accurate and direct measurement of the grating spaces of calcite and rock salt, and the selection rules for the frequencies of X-ray absorption edges. In conjunction with Larsson and Waller he was the first to deviate X-rays with a prism. They developed this method until they could obtain by it measurements of refractive indexes for X-rays which are of quite surprising accuracy.

In recent years he has been much occupied with the development and improvement of methods of measurement of 'ultra-soft' X-rays, the region between about 10 and 500 A., and with conspicuous success. This covers the gap between the ordinary X-ray region and the optical region of radiation.

He and his students have also been much interested in the values of the fundamental constants of physics and have made important contributions to our knowledge of them.

He has written a masterly book on the spectroscopy of X-rays. An extraordinarily large proportion of the information in it is due to the work of himself and his students. He has created an outstanding school at Uppsala and Stockholm, which now represents most of the physics of Sweden.

He was awarded the Hughes Medal in 1934.

A ROYAL MEDAL has been awarded to Prof. PATRICK MAYNARD STUART BLACKETT.

Prof. Blackett is especially distinguished for his work on cosmic rays and the particles connected with them.

The early work which first brought his name into prominence was concerned with the disintegration of nitrogen by α-particles; arising out of the experimental observations was the convincing proof that the disintegration process originated in the actual capture of the α-particle by the nitrogen nucleus.

The demonstration of cosmic-ray showers was one of Blackett's early successes with direct Wilson chamber photographs; but perhaps his most spectacular discovery—made simultaneously by Anderson in America—was that, in a large cloud chamber controlled by the tripping of counters, tracks appeared which could only be explained as due to a new particle—the positive electron. The importance of this discovery in the light of Dirac's theory was immediately realized by Blackett and his co-worker Occhialini, and important results have emerged.

Blackett also—in collaboration with Chadwick and Occhialini—extended the work on the positive electron, and it was soon found that there were sources other than cosmic rays. With the same collaboration Blackett was also instrumental in showing that quanta of sufficient energy could produce a pair of electrons, and this production was related to the so-called nuclear absorption of γ-rays—a phenomenon previously known but until then unexplained.

Blackett has followed up his cosmic-ray work and has published a number of very interesting papers dealing with various aspects of these rays. He has measured their energy, inferring therefrom a cosmic-ray energy spectrum; he has observed, with an extraordinarily high degree of accuracy, the scattering and energy loss of cosmic-ray particles in their passage through metal plates and has discussed the nature of the penetrating component of cosmic rays. Two papers on this topic appeared in the *Proceedings of the Royal Society* for 1938.

---

* From the remarks made by Sir William Bragg in presenting the medals for 1940.

Lastly, reference must not be omitted of Blackett's important experimental contributions to our knowledge of the heavy electron—the particle which seems destined to be of such importance in the understanding of the more familiar nuclear particles.

A Royal Medal has been awarded to Dr. **Francis Hugh Adam Marshall.**

Dr. Marshall's earlier research work (1903–7) on the œstrous cycle, corpus luteum, and removal and grafting of ovaries laid the foundations for all the modern discoveries concerning the internal secretions of the sex organs.

The publication of his large text-book on the "Physiology of Reproduction", in 1910, stimulated work on this subject throughout the world, not only on points of scientific interest but also in regard to the application to medicine and to questions of fertility and milk secretion in the domestic animals. He was engaged on a third edition of this book when war broke out. He is generally acknowledged to be the father of this subject, and but few papers on this branch of science to-day are published without some reference to his work.

Arising out of his research, and that of his pupils, the importance of the anterior pituitary as a source of internal secretions, affecting not only the sex organs but also other body functions, has been recognized, and has led the way to an enormous volume of research work in recent years throughout the world. It is one of the subjects in which the greatest advances have been made in recent years.

Recently, his research has been concentrated on the exteroceptive factors, such as light, ultra-violet irradiation and nerve stimuli, which affect the sex organs by way of their effects on the anterior pituitary. This work explains the physiological basis for the seasonal and other changes which occur in reproductive activity. He summarized this aspect of the subject in the 1936 Croonian Lecture on "Sexual Periodicity and the Causes which Determine It", besides adding new matter.

DAVY MEDAL

The Davy Medal has been awarded to Prof. **Harold Clayton Urey.**

Prof. Urey's first important piece of work consisted in carrying out extensive, accurate, spectroscopic measurements on diatomic and polyatomic molecules. This led him in 1931 to take up a detailed investigation on the abundance of natural isotopes of hydrogen, nitrogen and oxygen. During the next few years he succeeded in isolating deuterium and calculating the comparative thermodynamic properties of deuterium, hydrodeuterium and hydrogen. In 1934 he accomplished the first synthesis of deuteromethane.

Deuterium or 'labelled' hydrogen has proved of great value in investigating the mechanism of many organic and biologically important reactions, and its use has been the precursor of the modern general isotopic exchange reactions. A number of deutero derivatives have been prepared by Urey and his co-workers, and their entropies, vapour pressures and exchange equilibrium constants have been experimentally determined and compared with the theoretical values anticipated.

This isolation of deuterium from ordinary hydrogen and establishment of the thermodynamic, spectral and physico-chemical difference between it and pure hydrogen, as well as in the compounds containing deuterium and hydrogen, is a remarkably complete piece of work, for which Urey received the Nobel Prize.

More recently Urey has taken up the problem of the separation of the other important, naturally occurring isotopes: those of nitrogen, oxygen and carbon. He has examined their quantity distribution in Nature and employed exchange methods for the enrichment of one species.

DARWIN MEDAL

The Darwin Medal has been awarded to Prof. **James Peter Hill.**

Over a long series of years Prof. Hill has carried out researches on the development of various mammals, particularly as regards the embryonic membranes and placenta, and added greatly to our knowledge of this subject. Many of his conclusions have clear evolutionary implications, as for example that marsupials are descended from oviparous ancestors with meroblastic ova. In his Croonian Lecture of 1932 Prof. Hill summarized his researches on the embryology and embryonic membranes of the Primates. The views of primate evolution based on development which he then put forward are in accord with those of Elliot Smith founded on brain anatomy, and of W. K. Gregory on morphological and palæontological evidence.

In collaboration with T. T. Flynn, Prof. Hill has lately (1939) published the first part of extensive researches on the development of monotremes, both Ornithorhynchus and Echidna, which will be of great value in helping to assess the origin and relationships of these egg-laying mammals.

Prof. Hill's research work is of first-class quality, being trustworthy and carried out with extreme care and the best techniques; it has never been scamped and is rich in original results over a wide field, most of the conclusions having a direct bearing on evolutionary questions.

Few living biologists have contributed more towards the solution of problems bearing on the interrelationships of the main groups of the Mammalia and on the phylogenetic history of the Primates, a subject with which Charles Darwin was so much concerned.

SYLVESTER MEDAL

The Sylvester Medal has been awarded to Prof. **Godfrey Harold Hardy.**

G. H. Hardy is the author, or part author, of more than three hundred mathematical papers, two books, and several of the Cambridge Mathematical Tracts. Much of his work has been directed to the building up of the technique of modern mathematical analysis, and the simplicity with which the routine aspects of new work can now be presented is due very largely to fundamental results established by him.

It is characteristic of much of his work that it has stimulated others and has proved to be the starting-point of important developments. His work in collaboration with J. E. Littlewood on Tauberian theorems is an example. From an isolated classical result a subject was created which to-day would require a treatise for its exposition.

His most outstanding contributions to the advance of mathematical knowledge have been in the theory of the Riemann zeta-function and the theory of numbers. The achievement of which, it is believed, he himself is most justly proud is the invention of the 'circle method'. This is a technique of much beauty and generality, which brings great refinement of mathematical analysis to bear on a wide class of unsolved problems in the theory of numbers. The method has been elaborated and improved by other mathematicians, but on its account alone the name of Hardy must for all time rank high among the masters of his subject.

No appreciation of the services of Hardy to the advance of mathematics would be complete which did not attempt to assess the value of his personal influence. Throughout his career he has been the driving force behind a vigorous group of younger research workers. A very considerable proportion of the pure mathematical research now being published in Great Britain is traceable more or less directly to his interest and encouragement, or to the inspiration of his earlier work. His unstinted service during many years to the detailed work of the London Mathematical Society, and the freedom with which his experience and advice are available to all, have established him in a unique position in the regard of British mathematicians.

HUGHES MEDAL

The HUGHES MEDAL has been awarded to Prof. ARTHUR HOLLY COMPTON.

Prof. Compton has made a number of important contributions to physical science in the field of X-rays and elsewhere. Of late years he has been one of the leaders in the study of cosmic rays.

The experiments of Young and Fresnel early in the nineteenth century proved that light certainly had undulatory properties. But in the present century facts have been emerging, notably in connexion with photo-electric action, which are impossible to reconcile with the assumption that light can be described only as an electromagnetic wave of the classical type. These difficulties disappeared if light of frequency ν is assumed to be dynamically equivalent to a collection of particles of energy $h\nu$ (h is Planck's constant).

It occurred to Compton that from this point of view the interaction between radiation and free electrons is very simple, and in fact is the simplest interaction which radiation can undergo. Associated with the energy $h\nu$, according to the electromagnetic theory, there is momentum $h\nu/c$ (c is velocity of light). The interaction is thus reduced to a very ancient problem, that of the encounter of two infinitesimal billiard balls with known energies and moments. As the radiation moves with the velocity of light, in most cases the electron can be treated as if it were at rest. It is then obvious that in the collision the electron will acquire energy from the radiation, and the conservation of momentum requires that if the electron moves off in a certain direction the radiation will travel in a certain other direction. But reduction of energy of a quantum of radiation means increase in wave-length, and this increase will be a predetermined function of the direction of the 'scattered' radiation and of the direction of motion of the 'recoil' electron.

Compton published these conclusions in 1922. In 1923 he established the change in wave-length, first qualitatively by Barkla's absorption coefficient methods and then quantitatively with the X-ray spectrometer. In the succeeding years he investigated the energies of the recoil electrons as a function of their direction of motion and showed that the correlation, predicted by the theory, between the direction and energy of the recoil electrons on one hand and the direction and change of wave-length of the radiation on the other did in fact occur. This correlation is of fundamental importance in the general theory of the interaction of radiation with matter.

BIOLOGICAL APPLICATIONS OF SYNTHETIC CHEMISTRY

PROF. J. W. COOK, formerly at the Royal Cancer Hospital, who recently succeeded the late Prof. George Barger as regius professor of chemistry in the University of Glasgow, opened the winter session of the evening meetings in Edinburgh of the Pharmaceutical Society with a lecture on "Some Biological Applications of Synthetic Chemistry".

Prof. Cook said that many new facts have been recorded regarding the natures and the functions of substances which play vital parts in the process of life, and large numbers of these substances have been prepared artificially. Many rare compounds, not known in Nature, and yet possessing powerful biological activity, have arisen from the creative efforts of the synthetic chemist. The spectacular results which followed the introduction of the sulphonamide drugs were the outcome of purely chemical investigations. There is no doubt that prontosil, with its colourless prototype sulphanilamide, is destined to be regarded as one of the greatest boons to mankind conferred by this present age. Of the many thousands of sulphonamides that have now been prepared and examined, none surpasses sulphanilamide in efficacy against streptococcal infections. A later product, M. and B. 693, a sulphapyridine, has robbed pneumonia of much of its terror, and the analogous thiazole derivative has been claimed as effective against infections due to staphylococcus. These claims have not, however, been substantiated by tests carried out in Great Britain.

Much progress has also been made in other branches of chemotherapy ; new products are constantly being evolved which have therapeutic and pharmacological properties resembling, and sometimes exceeding, those of natural plant products. Carefully planned researches, such as those of the Drug Addiction Committee of the United States Public Health Service, should receive every possible encouragement. The very rapid decline in the use of cocaine as an addiction drug, after the discovery of synthetic substitutes such as procaine, gave a stimulus to efforts to solve the problem of drug addiction with the opium alkaloids, and the efforts of the American investigators have been concentrated on a study of the pharmacology of a wide range of morphine derivatives and of numerous classes of synthetic compounds having structural features in common with some of those of the morphine molecule.

The chemotherapy of tubercular infections, Prof. Cook said, is now receiving increasing attention. Sir Robert Robinson has recently summarized progress made in this field, pointing out that in tuberculosis, as in leprosy, a suitable therapeutic agent should provide a means of penetrating or breaking down the waxy envelope which surrounds the bacilli of these infections. The active component of chaulmoogra oil, long used in the treatment of leprosy, is known to be a *cyclo*pentenyl fatty acid. Many synthetic analogues of chaulmoogric acid also possess leprocoidal activity, and the nature of these substances gives support to the view that they owe their activity to a capacity to effect impairment of function of the fatty envelope of the organisms.

Prof. Cook also reviewed in the course of his lecture the progress made in the past ten years in the chemistry of the vitamins and the members of the sterol class, including several groups of hormones. Most of the known vitamins, he said, have been isolated in a state of chemical purity, and the principal ones have been prepared synthetically; in addition, the biological role of several of them has been partially elucidated. The pure crystalline vitamin A was isolated for the first time only a few months ago. The other principal fat-soluble vitamin, known as vitamin D, is now available commercially in chemically pure form. Ascorbic acid, or vitamin C, is now available as a synthetic product. Incidentally, it has been claimed that vitamins A and C increase the body's resistance to infection; this, said Prof. Cook, is now disputed, although it seems likely that vitamin A, by maintaining the tone of the mucosa, renders these less liable to attack by pathogenic organisms. The principal members of the vitamin B complex have been synthesized and considerable insight gained into their biological function. Two other vitamins which have yielded their secrets to chemical investigation in recent years are vitamins E and K. The availability of the pure synthetic vitamins will hasten the solution of problems concerned with their biochemistry and mode of physiological action.

Remarkable progress has also been witnessed in the chemistry of a group of hormones which are related in molecular structure to each other and to cholesterol, which, Prof. Cook said, may be regarded as their biochemical progenitor. Except in the case of the œstrus-producing hormone, total synthesis has not yet been achieved, but members of these groups have been converted into common degradation products, and the steroid hormones have all been prepared artificially from cholesterol or other sterols. Deoxycorticosterone, the most active of the life-maintenance hormones of the adrenal cortex, has been isolated from ox adrenals and is now prepared artificially in considerable amount. It is concerned in the maintenance of the sodium chloride balance in the blood and has been found effective in the treatment of wound shock; for this reason its availability at the present time is of particular importance.

CONTROL OF INFECTION IN WAR WOUNDS

The treatment and care of war wounds is essentially a bacteriological problem, as, indeed, experience in the War of 1914–18 made evident. The chief lethal micro-organisms that are found in infected wounds are *Streptococcus pyogenes* and the group of anærobic bacilli which cause gas gangrene. Researches within recent years into the causation of puerperal fever have shed light upon the origin of pathogenic streptococci in war wounds; in both cases the chief source of infection is regarded as being droplets of secretion that contain these microbes and that are expelled from the throat of those who nurse and treat the patients; the measure of the risk is given in the statement that 2–5 per cent of adults harbour *Streptococcus pyogenes* in the throat. Suitable masks should, therefore, be worn by all those who dress war wounds.

The danger from the intrusion of streptococci into wounds is likely to be much lessened by the administration of drugs of the sulphonamide group, although further experience is needed to define clearly the limits of their usefulness. The prophylaxis of gas gangrene is best attained by the early and adequate surgical cleansing of the wound and by the use of specific antitoxins corresponding to the chief types of pathogenic anærobe. The precise role of chemotherapy in combating infections caused by the gas-gangrene group of bacteria is still undetermined; recent experiments with laboratory animals indicate that the most favourable results will be obtained from combined sulphapyridine and antitoxin treatment. Tetanus antitoxin, which confers a passive immunity, still retains its place as an invaluable prophylactic agent; active immunization with tetanus toxoid—a non-toxic modification of tetanus toxin—was adopted last year as a voluntary method of protection for men in the Army and the Royal Air Force.

A small book on the subject, edited by W. H. Ogilvie and modestly styled a war primer ("War Primer on Wound Infection": its Causes, Prevention and Treatment. By W. H. Ogilvie, Robert Cruickshank, Lawrence P. Garrod, L. E. H. Whitby and G. A. H. Buttle. Pp. 96. (London: The *Lancet*, 1940.) 2*s*. 6*d*. net.) is the work of five recognized authorities, each of whom deals with a particular aspect of the treatment of civil and military wounds. The discussion is arranged under the chapter-headings: the problems to be solved; biological aspect; bacteriology; antiseptics; chemotherapy; surgical principles; and surgical procedures. The present state of knowledge has been set forth by the authors in a succinct and well-balanced manner. The facts they state and the conclusions they have reached deserve to be studied with the greatest care by everyone whose duty it is to assist in treating war wounds.

CULTIVATED CROPS IN EARLY ENGLAND

INVESTIGATIONS of a Danish committee appointed to inquire into the origins and development of agriculture in prehistoric Denmark have developed into a large-scale examination of recorded discoveries of prehistoric grain in northern Europe. In the course of this investigation, which has the support of the Rask-Ørsted Foundation, Dr. Hans Holbœk, on behalf of the Committee, visited a number of museums in England, Scotland and Ireland in 1939 for the purpose of examining the remains of prehistoric plants or their impressions on clay vessels from prehistoric and early archæological sites.

Pending fuller publication in collaboration with Prof. Knud Jessen, when that becomes possible, Dr. Holbœk has prepared a preliminary report on his examination of British prehistoric and Anglo-Saxon pottery in the Museum of Archæology and Ethnology in the University of Cambridge, which was completed only shortly before the entry of the Germans into Denmark (*Proc. Prehist. Soc.*, N.S. **6**; 1940).

The impressions found and indications of character, summarily stated, are as follows:

Emmer and spelt (*Triticum monococcum* Sch.). In bronze age barrows and the Late Bronze Age settlement of Mildenhall Fen in the form of impressions of grain and spikelets. *T. monococcum* L., the closely related small spelt, is also represented. Impressions of the threshed spikelets are characteristic.

Common wheat and club wheat. Distinguishable from emmer grains by their more rounded forms. As the evidence exists only in the form of charred grains or impressions, it is rarely possible to distinguish the race. In Cambridge there is only one impression of common wheat (*T. vulgare*), which comes from an Early Iron Age settlement (Abingdon), and the race seems to have been rare in early England.

Barley. As with wheat having a tough axis, the race of barley is difficult to identify. The prehistoric barley of northern Europe is the six-rowed form (*Hordeum polysticum* Doll.). It would appear that barley was always the chief grain of the Cambridge area. Naked and husked grains occur with equal frequency in the Bronze Age, but the husked form was almost completely predominant in Anglo-Saxon times.

Oats (*Avena sativa*). All impressions in the Cambridge material are of threshed oats, that is, without the husks and separated from glume and stem. Oats, presumably brought to Europe in the form of seeds, have been identified in the central European Bronze Age, and possibly were brought to Britain by the Romans. At Cambridge they are noted only in the Anglo-Saxon material.

Flax (*Linum usitatissimum*). Two flax seed impressions were found in the Anglo-Saxon pottery. In central Europe it is found in late Neolithic times, in Denmark from the Early Iron Age, and in Ireland on a site in Limerick of probably ninth–tenth century A.D.

Woad (*Isatis tinctoria*). Identified from impressions of the flat-winged fruit. In northern Europe it was cultivated so early as the Iron Age. The Cambridge evidence is of Anglo-Saxon date.

Investigations in other parts of Britain have established the fact that the knowledge of grain growing had already reached the British Isles in the latter part of the Stone Age.

FORTHCOMING EVENTS

Monday, December 9

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. W. G. East: "The Severn Waterway in the XVIIIth and XIXth Centuries".

Tuesday, December 10

Chemical Engineering Group in conjunction with the Institution of Chemical Engineers (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. A. B. Manning will open a Discussion on "The Salvage of Waste Materials in the Chemical Industry".

Royal Anthropological Institute (also for Members of the Royal Central Asian Society) (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—M. August Muhlenfeld (Director, West Indian Division, Netherlands Colonial Office): "The Badui: a Primitive Tribe of Eastern Java".

Wednesday, December 11

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. J. S. Nicholl: "Road Transport".

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Mr. A. L. Bacharach: "Some Nutritional Problems of War and Peace".

Friday, December 13

Royal Society of Arts (India and Burma Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. S. Lall: "Industrial Development in the Indian Provinces".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Master to take Physics and Mathematics—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middx. (December 14).

Graduate Teacher of Mechanical Engineering Subjects—The Principal, Hendon Technical Institute, The Burroughs, Hendon, London, N.W.4 (December 14).

Administrative Assistant (man) for Higher Education—The Education Officer, Education Offices, Katherine Street, Croydon (December 16).

Lecturer in Physics and Mathematics—The Principal and Secretary, Harris Institute, Preston (December 21).

Graduate Lecturer in the Mechanical Engineering Department of the Royal Technical College, Salford—The Director of Education, Education Office, Chapel Street, Salford 3.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 12: Organic Halogen Compounds. Pp. ii+6. (London: H.M. Stationery Office.) 2*d*. net. [611

Other Countries

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 11: Malayan Agricultural Statistics, 1939. By D. H. Grist. Pp. xii+102 tables. (Kuala Lumpur: Department of Agriculture.) 1 dollar. [411

U.S. Department of the Interior: Office of Education. Vocational Division, Bulletin No. 203 (Occupational Information and Guidance Series No. 3): Guidance Programs for Rural High Schools. By Paul W. Chapman. Pp. vi+58. (Washington, D.C.: Government Printing Office.) 10 cents. [411

Transactions of the Academy of Science. Vol. 30, No. 3: The Cytological Structure of the Hypothalamic Nuclei in relation to their Functional Connections. By Homer Dale Kirgis. Pp. 65–86. (St. Louis, Mo.: Academy of Science.) 50 cents. [511

Editorial & Publishing Offices :
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

NATURE

Telegraphic Address :
Phusis, Lesquare, London

Telephone Number :
Whitehall 8831

Vol. 146 SATURDAY, DECEMBER 14, 1940 No. 3711

SCIENTIFIC SOCIETIES IN WAR-TIME

IN times of peace London is unquestionably the focus of the scientific life of the British nation and Commonwealth. The reason is not that London is the seat of the metropolitan university, though this, by its system of external degrees, is also in a special sense the central university of the Empire ; moreover, it enfolds within itself many special institutions, like the Schools of Economics and of Hygiene and Tropical Medicine, which are themselves imperial centres for special branches of science. Nor is it that London is the seat of the chief national scientific departments, like that of Scientific and Industrial Research, or the Medical and Agricultural Research Councils. London had attained its position as the national scientific centre long before these modern bodies had been constituted, and before the University of London had come to be comparable, in size and influence, with the older Universities of Oxford and Cambridge (though as a centre of medical teaching London had long been pre-eminent). During two centuries and more in which the venerable sister Universities were still unrivalled except by each other, as centres of learning and research, their scientific members found a common meeting ground in London, in the rooms of the Royal Society : and during the nineteenth century London became the centre also of many more specialized scientific societies.

The relatively small size of the British Isles, and the excellence of their railway communications, make it conveniently possible for those who follow any special branch of science to come together, from all parts of Great Britain, to meet in London several times yearly. In this respect British men of science have an advantage not enjoyed by their colleagues in greater and more widespread communities like those of the Dominions, the United States, the U.S.S.R., or even Germany. In these countries regional centres have consequently developed, and national meetings tend to be annual and peripatetic, like those of the British Association. Such regional centres flourished also in Great Britain in the days before speedy travel became possible, but except in Dublin and Edinburgh they seldom attained the distinction of some of the principal academies of Germany, and with few exceptions they have declined since the days, for example, when Dalton was the glory of the Manchester Literary and Philosophical Society. Some of the chief British technical scientific societies, however, have in modern times developed valuable regional activities, in centres where meetings are held in addition to those at their main headquarters in London.

While the present War was still only a threatening possibility, the controlling bodies of some of the national scientific societies tried to prepare for future eventualities by arranging for the transfer of their offices from London, the safeguarding of their most cherished property, and alternative arrangements for meetings, in case the expected *Blitzkrieg* on London became a reality. On the outbreak of the War, some of these plans were carried out ; in other cases the councils of the scientific societies met to consider whether or not their pre-arranged series of meetings should be held. There were pessimists who thought it would be useless and undesirable to hold meetings, because of the absence, or absorption in war work, of many members, including some of the leading personalities. But in the main such counsels were not followed, and many societies held their meetings as usual throughout the session, from October of November until June, during the unexpectedly prolonged immunity of London from aerial attack. Towards the end of the 1939–1940 session, some of the societies reverted partly to their pre-War condition, by the return of their offices and staff to London, or by the partial reopening of their premises or library. Even through the dark days of the over-running of Norway, Denmark, Holland and Belgium, followed by the ominous signs of weakness that preceded the collapse of France, much of the scientific life of London was maintained. At the beginning of the summer recess there seemed hope that if the threatened invasion were forestalled or repelled, the autumn might see a resumption of London scientific meetings, little changed except for some decline in the numbers of those attending and of the papers presented.

In August, however, the long-postponed air attack fell upon London, and before the usual date of reassembly of the scientific societies, daily and nightly raids became a regular feature of London life. The question of the continuance of meetings has now acquired a more serious and perhaps controversial aspect in the new circumstances. Not only has the 'black-out' assumed if anything a deeper tinge than before, but also interruption and dislocation of road and rail transport has been caused from time to time by the enemy bombing. Especially after darkness has fallen and night raids have begun, travel is difficult and unpleasant, and late afternoon meetings, which in winter fall during the hours of darkness, are for this reason likely to attract few attenders. Still less likely is it that members would continue to stay to club dinners after such meetings, though in peace-time such dinners form a useful and pleasant supplement to the formal gatherings of the scientific societies.

The safest course would naturally be to discontinue meeting at all, at least during the darkest months of the winter. As a set-off against such a lapse in the ordinary activity of the societies, the sessions might be prolonged into what is in normal times the summer vacation, but which in these years of shortened or suspended holidays would be fully appropriate for scientific meetings. Some societies have already suspended their usual winter meetings, with or without an indication of the expected date of their resumption.

Others, bolder and (in the judgment of some) more admirable, are continuing to meet in London, either as usual or at an earlier hour, so that the meeting may be concluded before nightfall. In some quarters the holding of the regular meetings outside London has been considered, but except where societies have developed regional activities and centres in peace-time, it seems unlikely that such meetings would be so successful as afternoon meetings in London would be; this is partly because it remains much easier to travel to than any other centre, from places more than a few miles away, and partly because London and the surrounding counties still contain the largest number of potential visitors to scientific meetings. To those who live at a distance, in regions that have not suffered serious air attacks, it may seem to be merely foolish bravado to propose that scientific men should foregather in London; it should be remembered, however, that the millions of people who continue to inhabit the London area include many who would welcome scientific meetings not less than in peace-time, and who would feel no more in danger at such meetings than in any of the other places, of work or dwelling or recreation, which they frequent. This is perhaps insufficiently considered by some council members of scientific societies who, for whatever reasons, being unable or not wishing themselves to take part in such meetings, lend their influence to abandonment or postponement.

A more fundamental objection to the continuance or resumption of the winter scientific programme is raised in some quarters, as it was also in the War of 1914–18—that scientific meetings are intrinsically unjustifiable in war-time, being a misuse of hours that ought to be devoted to definite war work. This view ignores the fact that there are still many scientific workers, capable of helping to overcome our enemies, and anxious to be thus used, whose services have not been called upon, or have even been declined when offered. But even as regards those whose time is actively occupied in scientific war work, the criticism seems answerable. Neither manual nor intellectual workers can work all their waking hours; some leisure and refreshment of mind are necessary to enable a man to do his best work; and the solution of a pressing war problem may be facilitated, not retarded, by a break in the routine hours of labour, and by meeting with colleagues who share similar peace-time scientific interests, whether or not they are likewise now engaged in war service.

Almost all the general arguments that justify the expenditure of time and travel involved in attendance at scientific meetings in peace-time remain valid also in war-time. Just as a Christian finds no less need now than in normal days to assemble in church with his fellow worshippers, so the man of science still needs to maintain his contacts with fellow workers and with scientific progress outside his own special activity. War is not exclusively a matter of the organization and execution of material defence and attack; the mind no less than the body and the spirit must be kept in sound condition in order to continue to develop these material measures.

The officers of scientific societies, however, doubtless find other obstacles to meeting than those of risk and travel difficulties. The work of scientific technicians is now largely directed to war problems the solutions of which must for the present be kept secret; and so many workers in pure science are now drafted into the technical defence services that the output of pure research which can be safely published in war-time is much reduced. These factors are in one way a help to societies, in reducing the pressure on their resources of money (and of paper) for publications: but unless the societies are to fall into a state of suspended animation that may seriously prejudice their future revival, some degree of publication must be continued. The volume and perhaps even the standard of the papers published and read may be somewhat reduced, but the sources are scarcely likely to dry up entirely; and a shortage of papers for reading at meetings can be eked out partly by a moderate reduction in the length of the meetings, and also by arranging discussions, a course which has been so successfully followed by the Royal Society in recent years.

ENTOMOLOGY OF STORED PRODUCTS

Insect Pests in Stored Products

By H. Hayhurst. Pp. xii+83+49 plates. (London: Chapman and Hall, Ltd., 1940.) 15*s*. net.

As a guide to the industrial chemist desirous of learning something of the appearance and mode of occurrence of the insect and arachnid pests of stored products this book is useful. The excellent illustrations by Mr. Harry Britten are numerous, the description of the insects is reasonably adequate, and the emphasis laid on cleanliness in stores and in vehicles of transport is sound. A list of "substances and their pests" is given as an appendix to the book and there is a short index of contents. The inclusion of the moths Plodia and Ephestia among the "substances" as "subject to attack" by the parasitic wasp Habrobracon is amusing.

Doubtless this book is, as Sir Harold Hartley points out in a foreword, intended for the industrial chemist. It is to be regretted that the author did not amplify on one hand, and simplify on the other, to meet the needs of warehouse managers, foremen and others who are the parties immediately concerned with infestation. While it is useful to have short descriptions of the insects infesting stores and warehouses, together with short accounts of the products on which they commonly occur, collected into a single small handbook, the most urgent need in combating insect infestation of food and other stores is a better understanding of how infestation occurs, and how it may attain an alarming extent and how only organized and concerted action can really cope with it. These matters are not discussed.

To the reader conversant with the literature, Mr. Hayhurst's sources of information are obvious; but he might have acknowledged them, including the source of material for Mr. Britten's illustrations, and in doing so have enabled his colleagues in the railway companies and elsewhere to read for themselves what is known of their problems and to keep in touch with the rapid progress in the understanding of them and towards their solution which is now being made. The early work of the Empire Marketing Board in this field is wholly ignored, although in his preface Mr. T. W. Jones refers to the subsequent work of the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades. The work of Drs. Page and Lubatti in the science and practice of fumigation is not even mentioned. The great improvement in insecticides for use in warehouses, achieved by Dr. Charles Potter, is referred to; but no mention is made of any of his papers on the subject, which are of high importance, both scientifically and practically.

It is a real defect in Mr. Hayhurst's book that no bibliography of the subject is given. The cost of the book is high, and, in the absence of references to sources of information whereby the reader could extend his knowledge, excessive.

One comment on Mr. Hayhurst's book may be made. It illustrates very well how, outside the research laboratories, the entomology of stored products is still in that early stage of development where description of the insects concerned and general recommendations about their control represent the knowledge apparently acceptable and satisfying to those dealing with infestation. That there are scientific principles underlying the problems of infestation and the methods by which they may be solved is only vaguely realized. Nevertheless Mr. Hayhurst's book shows a real awakening on the part of the industrial chemists to the need for tackling their infestation problems seriously, and the author is to be congratulated on a highly creditable performance within the rather narrow and now old-fashioned conception of applied entomology as a branch of zoology concerned less with the discovery of new laws and principles than with the immediate control of noxious insects. We may look to the work of the new Pest Infestation Laboratory of the Department of Scientific and Industrial Research to dispose once and for all of that old-fashioned view, and to give the lead in industrial entomology which has been so long deferred in Great Britain and in the Commonwealth. J. W. MUNRO.

VEGETABLE PATHOLOGY

Diseases of Vegetable Crops
By Prof. J. C. Walker. New edition. Pp. iii+67. (Madison, Wis.: The Author, University of Wisconsin, 1939.) 1.75 dollars.

THIS publication is printed in the style known as typewriter type, being, in fact, a reproduction of the author's typed notes bound (quarto size) in stiff paper covers. It is doubtful whether this form of printing will be welcomed by readers, for the variation in ink density is tiresome and may even be tiring to the eyes.

The book is primarily intended for the use of advanced students of vegetable pathology, but the hope is expressed that it may be of some value to workers in research and applied branches of the subject. Its purpose is to supply an outline of important facts concerning diseases of vegetable crops in the United States; it follows that British readers may be unfamiliar with some of the crop plants and the methods used in their cultivation.

The diseases are arranged under headings of host plants or related host groups. Important diseases are treated in detail but with a brevity of style typical, and no doubt necessary, in publications of this kind. For each major disease the information supplied includes host range, history of the disease, its geographical distribution, its economic importance, the host symptoms, life-history and description of the causal organism, environmental conditions, varietal resistance (if any), and various other factors, concluding with particulars of control measures. After each disease there is a list of references to literature; these are indicated by numbers at suitable places in the text wherever relevant to the point under discussion.

Minor diseases, as might be expected, are dealt with less exhaustively, but a very large number are mentioned, the individual treatment varying from a single sentence to short paragraphs containing descriptions of symptoms and methods of control.

A feature that will be welcome to many readers is the inclusion, after each host heading, of notes on current methods of cultivation and of marketing the crop. Such knowledge of a crop is, as the author mentions in his introduction "basic to an adequate understanding of the development of its diseases and of their control". This point of view is one to be commended to English writers on the subject.

Workers in Great Britain who purchase the book will, in the main, find much that will interest them, although they may be surprised that such a well-known control practice as the mercuric bichloride treatment against club root in cabbages is not mentioned. Nor, in seeing some of our well-known diseases here listed as very minor troubles, must we forget that this publication is written primarily for American workers and in this respect fulfils its purpose in a very workman-like manner. It stresses the importance of a practical knowledge of crop requirements as an aid to dealing with disease problems, which aspect of plant pathology is somewhat neglected in training British students.

The references to literature are chiefly limited to American publications. This may be expected, but although the book is primarily intended for American readers it could, with little extra work, have been made more attractive to British plant pathologists. It can be considered a useful, but far from indispensable, addition to our reference shelves.

The text is singularly free from mistakes, but some unfortunate error in pagination has resulted in one half of the diseases in the index and three quarters of the table of contents possessing wrong page numbers. On page 65 in the index Crucifers (contnd) should read Curcurbits (contnd).

The book is more informative than a mere bibliography and despite the absence of any illustration is, at the price, good value. It is obviously meant for home consumption and a limited circulation. D. E. GREEN.

CHEMISTRY OF OSMIUM AND PLATINUM

Gmelin's Handbuch der anorganischen Chemie
Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 66 : Osmium, mit einem Anhang über Ekaosmium. Pp. xx + iv + 100. 14.25 gold marks. System-Nummer 68 : Platin. Teil A, Lief. 1 : Geschichtliches Vorkommen. Pp. 146. 16.50 gold marks. Teil B, Lief. 1 : Physikalische Eigenschaften des Metalls (bis thermische Eigenschaften). Pp. 72 + iv. 8.25 gold marks. (Berlin : Verlag Chemie, G.m.b.H., 1938–39.)

THE parts of "Gmelin's Handbuch" under notice deal with osmium and platinum. Osmium, the heaviest of all known substances, has a high melting point and is harder than glass and quartz but is scratched by topaz. Its scarcity and its tendency to form the highly poisonous, volatile, strongly smelling tetroxide prevents its commercial exploitation. It is a highly efficient catalyst, especially in hydrogenations. The tetroxide dissolves in water to give a neutral solution with an extremely small electrical conductance ratio, but it forms salts with bases. It is readily reduced to lower oxides or to the metallic state. Thus in alkaline solution its valency falls to 6, and in neutral and acid solution to 4, the dihydrate of osmium dioxide being formed ; but reoxidation by oxygen is readily affected so that it is an excellent oxygen carrier. With concentrated hydrochloric acid it gives chlorine. On heating the metal in chlorine a series of intensely coloured sublimates is formed. These are difficult to separate, but at 650° C. a black tetrachloride can be obtained.

Osmium forms a large number of complex co-ordination compounds, such as potassium nitrosochloride, $K_2[OsNOCl_5]$, osmiamic acid, $H[Os\ O_3N]$, a hexacyanide, $K_4[Os(CN)_6]$, and numerous organic derivatives. Six isotopes have been described by Aston and one by A. O. Nier. Eka-osmium, element 94, is known only in the form of two artificial isotopes produced by bombardment of uranium with neutrons.

The first part of the volume on platinum deals only with historical notes on the discovery of the six metals of the group and with their geological origin and geographical distribution. Although platinum has been found in ancient Egyptian works of art, it is probable that its employment for the purpose was accidental, its identity not having been recognized. There is evidence of its use in South America before the discovery of that continent by Columbus, but it was not until the middle of the eighteenth century that it began to attract general notice. W. Watson described its properties in the *Phil. Trans.* of the Royal Society in 1749, without, however, laying claim to its discovery. Thenard first observed its catalytic properties in 1813 during his investigation of the decomposition of ammonia, and in 1817 Sir Humphry Davy described the flameless combustion of various gases in presence of the metal. Palladium was discovered by Wollaston in 1803, but his discovery was first revealed anonymously and it was not until after he had obtained another new metal, rhodium, that he revealed his identity in 1805. Iridium and osmium were both discovered in 1804 by Tenant, while ruthenium remained unknown until isolated by C. Claus in 1844.

During the segregation of minerals in the earth's crust all the members of the group except palladium have passed almost completely into the metallic phase, while palladium with some platinum and ruthenium occurs in the form of sulphide. Geological maps of the distribution of platinum-bearing minerals in the Ural Mountains are given. Before the War of 1914–18, 95 per cent of the world's supply came thence. Apart from deposits in Spain and Siberia, the minerals bearing platinum occur in three zones of mountain ranges : (1) in America between Alaska and Chile ; (2) from eastern Australia through the Philippines to Japan ; and (3) from the Urals through Abyssinia to Rhodesia.

The second part of the section on platinum deals exclusively with the physical properties of the metal. Five isotopes are known, and an account is given of their formation by bombardment with deuterons and neutrons as well as of the transformation of platinum nuclei into other elements. It is suggested that the protons and neutrons of the nucleus may to some extent be combined to α-particles. The crystal lattice is made up of face-centred cubes with four atoms in each cell, no polymorphism having been established.

Hydrogen is the only gas which diffuses through the metal ; even after two months no trace of air has been found to diffuse into an evacuated vessel through platinum foil 0·02 mm. thick. Curves are given showing the influence of changes of temperature and pressure on the rate of diffusion of hydrogen. Diffusion is not noticeable below red heat, and since the rate is proportional to the square root of the pressure it has been suggested that diffusion is preceded by molecular dissociation. Some difference of opinion exists as to whether hydrogen released in electrolysis at a platinum electrode penetrates the metal or not by true diffusion. As the rate of diffusion of heavy hydrogen is about three fourths of that for ordinary hydrogen, the difference is not enough to facilitate the separation of the isotopes.

THE CONQUEST OF ENERGY

Atoms in Action

The World of Creative Physics. By George Russell Harrison. Pp. x+370+16 plates. (London: George Allen and Unwin, Ltd., 1940.) 12*s*. 6*d*. net.

It is sincerely to be hoped that no one will be misled by the title of this book. "Satan's invisible World Displayed" was not, as Herr Teufelsdröckh imagined, a history of the British Press; nor is "Atoms in Action" just another addition to the number of books which attempt to convey to a bewildered, and by now rather blasé, public the latest inside information about the structure of the atom. Of course, atoms come into it—atoms, as everyone who has ever attempted high vacuum technique knows only too well, leak in everywhere—but the operative word in the title of Prof. Harrison's book is not "Atoms" but "Action". "Almost every material problem of living," writes Prof. Harrison, "turns out in the last analysis to be a problem in the control of energy. That part of the cost of a lady's hat which does not represent business acumen on the part of the milliner is for stored and directed energy—the atoms of matter of which the hat is composed are permanent, and will still exist when the hat has been discarded and burned. Only energy and knowledge of how to apply it are needed to recreate a hat from its smoke and ashes."

Energy, its control, distribution, and utilization in modern times is the theme of the book, and a very stimulating theme it is. "Every dweller in the United States," we are reminded, "is now served, on the average, by energy equivalent to that which could be provided by thirty slaves such as sweated at the command of an ancient Egyptian king. In making this much energy available, science has contributed only a small fraction of what it can contribute. Human beings can be made twenty thousand times as wealthy as they are to-day; but only fundamental investigation of nature, such as is involved in 'atom smashing', will show how."

Prof. Harrison's main purpose in producing this book—which by the way was written at the instance of the American Institute of Physics—is neither entertainment nor instruction, though he gives his readers plenty of both. Essentially the book is a plea for research, and still more research. "Experience," he claims, "has shown no better way of eliminating poverty than by well-directed 'atom-smashing'," and in successive chapters of the book he drives home his statement by examples drawn from many branches of modern industry. He tells us, to mention but a few of the topics, of the applications of physics in farming and in medicine; of cold storage and illumination; of radio and television; and of the harnessing of the electron for electrical control: nor does he overlook such mundane, but important, matters as "profits" and "costs".

Even to a physicist who, for various reasons, has kept in fairly close touch with industrial developments of the subject, it is a thrilling story when compressed, as it is here, into a single volume; and Prof. Harrison tells it extremely well. He has a charming style, a flair for the exact phrase, an eye for illuminating and unusual comparisons, and a sly sense of humour which, without being obtrusive, gives sparkle and zest to the text. The chapters run on with the informality, the clarity, and the absence of intrusive technicalities which characterize the very best kind of talk; and at the end the reader finds that he has learned almost all he wanted to know of the subject, and (perhaps equally important) he has not been bored with things he did not want to know. In writing his progress reports, Prof. Harrison has been able to tap original sources of information (some of it unpublished) available in many of the largest research organizations in America. It may be taken that his stories are as authentic as they are interesting.

Some appreciation of the achievements of science, and the methods by which they have been reached, is nowadays an essential part of a good general education, and no better mentor has yet appeared than Prof. Harrison. In particular, it is much to be desired that "Atoms in Action" might find its way into the hands of all Cabinet Ministers, present or prospective, of heads of departments, and business directors. For, as its author reminds us, the end is not yet!

> "Still o'er the earth hastes opportunity,
> Seeking the hardy soul that seeks for her."

Much will depend in the future on our preparedness to seize the opportunity presented to us in the almost infinite possibilities of well-directed physical research. J. A. CROWTHER.

MEMOIRS OF AN IMMUNOLOGIST

As I Remember Him:
the Biography of R. S. By Hans Zinsser. Pp. x + 369. (London: Macmillan and Co., Ltd., 1940.) 12*s.* 6*d.* net.

THIS book must be accounted a notable achievement when we consider that it is the parergon of one who spent a strenuous life devoted to researches in the fields of microbiology and immunology. The reader should keep clearly in mind that the author, Dr. Hans Zinsser, who was professor of these subjects in Harvard University until his recent death, adopted the fiction of narrating the events of his own life and experiences as if they had happened to "R. S.", a mythical friend. The author wrote the last chapter, which describes the thoughts of "R. S." during his fatal illness, when he himself was under the shadow of impending death. He did not use the device of anonymity in order to heighten his self-importance. On the contrary, he took pains to assure the reader that his objective counterpart was an ordinary intelligent person who was often not really competent to pronounce opinions on many of the topics that are discussed in the book. This modest attitude is stressed in the first chapter and also in the final sentence of the last chapter, which states that it seemed scarcely worth while to have written a book about his 'friend'—a view which is unlikely to be shared by its readers.

Zinsser's father migrated to the United States from the Rhineland and his mother from the region of the Black Forest. Their children were born in the New World, and the author tells us that he spoke no English until he was ten years of age. His youthful ambitions were directed towards a literary career, but the researches of Edmund B. Wilson on cell division so fascinated him that he chose biology as a subject of study and was later advised to take a medical course. He tells in an amusing fashion how an attempt to combine practice in New York with laboratory work proved unsuccessful and how he then specialized in bacteriology, lectured to students, directed the work of his research assistants, and in odd moments scribbled sonnets on scraps of paper.

In the course of time an intensive study of the mode of spread of typhus fever led him far afield: to Serbia, Mexico, Tunisia and Russia. He greatly admired France, had many French friends and thought Paris the most civilized city in the world. He makes vivid for us the romantic feelings aroused in him there as a youth of twenty-one; and he recalls memories of spring in the Luxembourg Gardens and of the rhymes of Ronsard, Villon and Verlaine ringing in his head. When he had become a noted man of science, he was appointed visiting professor at the University of Paris, where he lectured in French to the students, and his experience forms the basis of an interesting discussion on the relative merits of French, German and American universities. During the visit his friend Vallery-Radot gave him a copy of Pasteur's will, with permission to quote it in this book; the will consists of three simple sentences embodying two equally simple wishes. Readers in Great Britain can scarcely fail to remark that the author's love of France apparently left him little room for appreciating British characteristics and cultural values; perhaps he found it difficult to break down the barrier of British national reserve. However this may be, it is certain that we should have enjoyed his candid comments for, as his book abundantly shows, he was a kindly and tolerant observer of human nature. He deplored the political degradation of Germany and had looked forward in vain to its transformation into a free Republican State.

Towards the end of his life he visited Japan and China, and found in Peking a source of charm that no other city except Paris had ever held for him; he was attracted, too, by the people, a natural consequence of his friendship with many Chinese collaborators during a period of more than twenty years.

Dr. Zinsser was a versatile man with a wide range of intellectual interests, and thus he was drawn to those whose view of life was not bounded by their specialty but—in his own phrase—whose minds swept the horizon. He notes that his friend the late Dr. Charles Nicolle, for many years an expert in tropical medicine and director of the Pasteur Institute in Tunis, was novelist, philosopher and historian; and that Laennec, the inventor of the stethoscope, was an accomplished pathologist, classic, flute-player and horseman. Unlike some of the younger men of science of the present day he possessed a strong historical sense, and took pleasure in viewing modern ideas, customs and methods in the light of the past.

This book contains a wealth of reflections on a great variety of medical, educational and political subjects; and, since the author has an easy style with a talent for descriptive writing that is enlivened by humorous and ironical comments, the reader's interest is never allowed to relax.

G. F. Petrie.

THE UNIVERSITY OF ICELAND

By Pjetur Sigurdsson,
Secretary, University of Iceland

THE University of Iceland was founded on June 17, 1911, the hundredth anniversary of Mr. Jón Sigurdsson, who was a profound scholar and the nation's leader in her struggle for independence in the nineteenth century. It began its activities with four faculties, namely, theology, medicine, law and philosophy, the last-named comprising the Icelandic language, history and literature, besides philosophical studies. At first the teaching staff consisted of ten professors and a few lecturers.

The University was at first housed in the Parliament building, but this accommodation soon proved too small and inconvenient, and for more than twenty years the University authorities fought strenuously to obtain a separate building. At last, in 1933, they obtained the sole right to establish a money lottery in Iceland, with the view of defraying the expenses of a new building, suitable for the University and in every way meeting modern demands.

Prof. Alexander Jóhannesson, Ph.D.
Vice-Chancellor, University of Iceland.

The lottery commenced operations in 1934, and the University building was begun two years later and brought to completion this year,* partly by borrowed money to be repaid in the course of the next few years out of the profits of the lottery. The new building was dedicated on June 17 last, and teaching began there this autumn.

The main building is about 240 ft. long and is three-storied, with a wing running out from the centre at the back. On the ground floor are the offices, the lecturers' common room, the reading-room, and the library, biological, physiological and pharmacological laboratories, and a research room for the investigation of foodstuffs.

On the second floor are nine lecture rooms, the collections and apparatus belonging to the Medical Faculty, the chapel, and the great hall.

On the third floor are fourteen workrooms for the teaching staff, while the rest of this floor will, to begin with, be placed at the disposal of other schools.

The University forms the largest building in Iceland, so far, and in more respects than one it marks an epoch in Icelandic architectural style. Most building materials have to be imported from abroad, but in the new University native material has been used to a much larger extent than heretofore and in a manner different from what has hitherto been known here. Prof. Gudjón Samúelsson, the State architect, who designed the building, also supervised its construction.

Besides this new main building, there are other buildings connected with the University; such as the Students' Hostel, built in 1934, the University Research Institute, built in 1936, both standing in the University grounds, a very large and beautifully situated plot on the outskirts of Reykjavik. There are also pathological and bacteriological laboratories housed in one building near the Landspítali (State Hospital), and built in 1934, where part of the instruction in medical science is given, while the rest is given in the State Hospital and the University building. In this building, too, researches are made into animal diseases, for, besides the old endemic ones, various other dangerous sheep diseases, hitherto unknown in this country, have come in recent years.

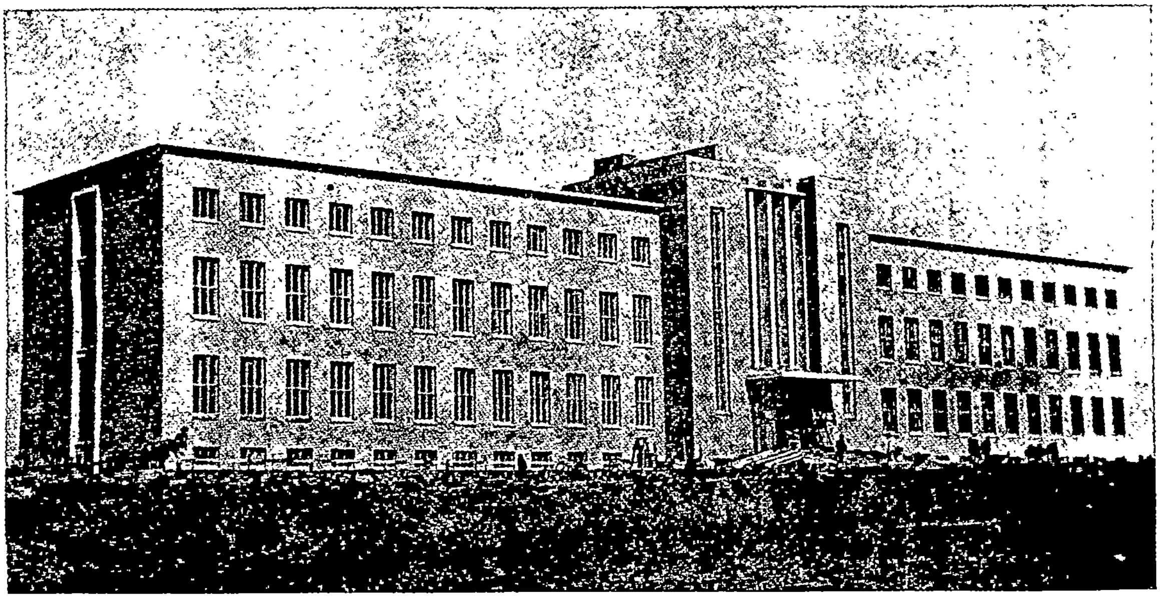
In the University Research Institute there are the Departments of Fisheries, Industry, and Agriculture.

The Students' Hostel can accommodate thirty-eight students. There are also a reading-room, a dining-room, and a sports room.

The University is attended by some 290 students, and its teaching staff comprises fourteen professors and as many lecturers. The principal aim of the teaching is to prepare the students for official careers in the State, for scientific work is more difficult here than at the big universities of other countries. Yet, as mentioned above, both the University and the medical research department have undertaken researches into animal diseases and done good work.

The Philosophical Faculty lays the main stress on teaching the Icelandic language, history, literature, and old Northern lore. This Faculty will lead in all work done in the field of national learning. Though the Icelanders have preserved the old cultural treasures of Scandinavia better than any other nation, yet most of the old manuscripts in which these treasures are to be found are kept in foreign museums, particularly in Copenhagen. These MSS. were exported to Denmark at a time when Iceland was ruled from Copenhagen. But as Iceland has now become a free and independent country and only united to Denmark by a common king (a tie which the present events rent asunder early in April last) negotiations are being carried on with the view of getting the old cultural treasures, such as MSS. written by Icelanders on Icelandic and Scandinavian matters, returned to Iceland. If this can be achieved, which there is no reason to doubt, the University of Iceland will be in a position to play a still more important part in research into the old Northern lore. For doing such work the Icelanders are better equipped than other nations, because the tie between the present and the past forms of their language and literature has never been rent asunder. Every Icelander thoroughly understands the old literary works which were written some eight hundred years ago.

Though our University is small, it works in the same spirit as other universities, and with the same zeal and sincerity for the good of the nation and for the promotion of learning.



New Building of the University of Iceland.

THE STUDY OF PREHISTORIC TIMES*

Though T. H. Huxley, having established beyond the reach of criticism 'Man's Place in Nature', considered that his duty as biologist and anthropologist stopped short at the limits of organic evolution, he realized, perhaps before anyone else, that the principles of evolution did not stop there. He was well aware that when a primate had made a tool and had thus become entitled to be called a man, a new vista was opened in the realm of evolution, and that by the creation of extra-corporeal organs man had discovered a new method of adjusting himself to his environment. Just as the doctrine of evolution, when applied to plants and animals, is the fundamental theme and focus of all biological research, so the evolution of civilization should hold a like place in anthropological studies, and its most important duties should be to trace, step by step, man's progress in the development of his material civilization, the evolution of his varied forms of social organizations, allied as these are with the growth of his religious conceptions and practices, until the whole series is complete from the primitive flint tool to the aeroplane or television, from the simple family group to the nation or empire. Here attention is directed to the methods that have been used and are still being employed to reconstruct man's behaviour during the period before writing was known that is termed 'prehistoric'.

---

* Substance of the Huxley Memorial Lecture of the Royal Anthropological Institute delivered by Harold J. E. Peake on November 26.

Few, if any, peoples, however primitive, are not interested in their past. They have embodied it in tradition; while other tales, related to explain natural phenomena, are embodied in myths. This body of tradition and myth, especially in the highly elaborated forms, such as are found in the Homeric poems and other great national and tribal epics, are the only available accounts of prehistoric times. Study of these records has oscillated between acceptance and sceptism; but sufficient confirmation has accrued from such archæological investigations as those of Schliemann at Mycenæ, Sir Arthur Evans in Crete and others, to justify acceptance of legend as containing a germ of truth about the deeds of heroes and about prehistoric times.

Philological studies, beginning with the investigations of Sir William Jones on the relations of Sanskrit, Greek, Latin and German, of which the results were embodied in an address delivered in India in 1786, have, as the result of much speculation and discussion, been responsible for theories as to linguistic and racial origins and pictures of prehistoric times, which in so far as justifying the theory of a predominant Aryan race is concerned, have failed to retain a place in scientific theory.

While the Aryan theory based on linguistic evidence has thus come to be discredited, study of the physical characters of the populations of Europe, and of human remains dating from prehistoric times, has led up to the classification which took final form in the work of W. Z. Ripley (1900), who argued that Europe had been peopled by three races, the Nordic, Alpine, and Mediterranean, though the existing populations show a large number of intermediate types owing to intermixture.

In the nineteenth century another line of research was pursued in the hope of throwing light on the social and economic organization of prehistoric peoples. Studies of the village communities of Denmark by Olufsen (1821) and of the German mark by von Maurer indicated the existence of village communities with common ownership and cultivation of the soil among all Germanic, Scandinavian and Celtic peoples. Further studies of the village communities followed, beginning with those of Sir Henry Maine based upon his experience in India. In Britain, Seebohm's view of the pre-Saxon origin of the village community has recently been revived, with additions by Peake in the suggestion that the three-field system may have reached Britain from the Danube basin about 1200 B.C., while it is suggested that both the 'Celtic' rectangular enclosure first identified by Crawford from the air and the 'long strip' system may characterize distinctions marked between the central European populations in the Middle Bronze Age, and possibly represented in successive migrations into Britain in the beginning of the Late Bronze Age, which brought two distinct types of cultivation with them.

So far, except for a number of skeletons with reliable associations, none of the evidence upon which these methods of inquiry depend is of prehistoric date. The only science which has at its disposal an almost endless supply of contemporary documents coming down to us from prehistoric times is archæology—and this, too, is strictly limited to material culture.

It is only within the last few generations that archæology has attained to sufficient precision in its methods to be worthy of being called a science. The study has passed through many phases; and it may not be valueless to trace the succession of ideas that has marked its progress.

In very early days, men noticed ancient monuments which they attributed to their legendary heroes, as did Pausanias at Tiryns and Mycenæ. Hesiod realized there had been a bronze age before the age of iron; but Lucretius was the first to make a clear statement on the matter; the belief, however, that stone, and perhaps copper, and bronze, implements were thunderbolts was widespread. The study of legendary material in the Middle Ages, of which the work of Geoffrey of Monmouth is a conspicuous example, continued until towards the end of the sixteenth century, when Camden in his "Britannia" started a new scientific method by interpreting ancient monuments in the light of statements made by classical writers.

The first to appreciate the true significance of stone implements was Michaelis Mercatus (*ob. c.* 1590), who made a definite pronouncement that they were made by men before they knew how to use metal, and Dugdale also, in 1656, attributed polished flints found at Oldbury in Warwickshire to men ignorant of the working of iron or brass.

Prehistoric questions aroused considerable interest in Great Britain, though early remains were usually attributed to the ancient Britons or the Druids. In the meantime, the work of a commission appointed to investigate the history of Denmark in 1806 led C. J. Thomsen, after studies extending over twenty years, to divide prehistoric times into three phases: the ages of stone, bronze and iron.

In France the work of Boucher de Perthes in the Somme valley, first published in 1838, led in 1859 to the acceptance by British geologists and archæologists of the Abbeville implements, as pointing to the existence of man here "at a period remote beyond any at which we have hitherto found them", while it was made clear from these discoveries that the Stone Age must be divided into two, as Lubbock suggested, namely the Palæolithic and Neolithic Ages.

The discrimination between cave and drift implements in the Palæolithic period initiated a series of classificatory systems which culminated in 1912, when Breuil added the Aurignacian to those familiar phases of Chellean, Acheulean, Solutrean and Magdalenian. For a time, this sequence was considered final; but discrepancies have since necessitated some revision.

The discovery of the Swiss pile-dwellings in 1853 led to the conclusion first formulated by Keller that the neolithic civilization and domesticated animals were first introduced from Asia about 5000–4000 B.C. The attempt to fill in the gap believed by some to exist between palæolithic and neolithic led to the investigation of the Danish shell-mounds by a committee appointed in 1860, the identification of the Tardenoisian and Azilian cultures, and finally in 1921 to the recognition by R. A. S. Macalister that this so-called gap covered cultures which he grouped together as "Mesolithic".

Thus between 1836, when Thomsen recognized the three ages of stone, bronze, and iron, and 1921, archæologists had framed a system of relative chronology extending from Harrison's Eolithic, the earliest period, down to the close of prehistoric times. How such a relative chronology became converted into a positive chronology, at any rate for the later phase, may now claim attention.

Excavation of archæological sites, the examination of monuments and the decipherment of inscriptions, supplemented by tradition embodied in written documents, in Egypt, Mesopotamia and Greek lands, made possible correlations to which Crete and Egypt contributed largely, and upon which it became possible to work out a chronological system making a framework for archæological discovery extending from the fourth millennium B.C. or earlier, down to historic times.

The diversion of interest in archæological excavation from buildings, objects of art, and inscriptions, to which it had been directed in the nineteenth century, to the lesser finds, and especially pottery and sherds, opened the way to the study of cultural complexes and their distribution. This led up, through the work of Ratzel, Graebner, Rivers and others, to the more extravagant theories of the Diffusionist school, which traced the origins of all cultural development back to ancient Egypt. For a time, a violent reaction against such extreme views precluded advance along these lines; but a saner perspective in more recent work, accepting the principle, and tracing the diffusion of culture elements from the Aegean area, has laid the foundations of a chronology for the greater part of central, northern and western Europe, with a margin of error of rarely more than a century, from the middle of the fourth millennium B.C. The chronology of the pre-agricultural stage is still uncertain, but hopes are entertained that this may in time be reduced to some semblance of accuracy by studies and methods which collectively may be called geochronology.

Among pitfalls to which the archæologists of the past have been prone, and to which we ourselves are still inclined, is a too rigid adherence to such classificatory distinctions as palæolithic, mesolithic, neolithic and the like, which, while convenient enough for the purposes of the museum curator, do not represent the actual conditions of life in prehistoric times, when these periods and cultures were not marked off from one another with such extreme precision. These arbitrary divisions cut across many vital distinctions. The difference between Lower and Middle Palæolithic has disappeared; while the first great break in continuity occurred, it is believed, early in Aurignacian times with the arrival of *Homo sapiens* in Europe. The next great break occurred with the cultivation of grain and the taming of wild animals, indicating the neolithic age and making settled life a possibility.

When we consider the long duration of the mesolithic age and the still greater length of time occupied by the various phases of the palæolithic, it seems unnecessary to divide into a number of comparable ages the period during which crops have been cultivated, namely, a period of little more than 7,000 years. Most archæologists are coming to the conclusion that the stages in metallurgy do not form the most convenient divisions for the grain-growing age. It has long been clear that in Britain the Middle Bronze Age, when successive waves of invaders from central Europe forced themselves into the country, a movement also apparent all over Europe, caused a greater break in the continuity of culture than the various advances in metallurgy. In a recent work, Hawkes has suggested that the first period of the development of culture in Europe closed with the fall of the Palace of Knossos. A second grain-growing period may conveniently be regarded as ending with the coming of the Romans. There is much, however, to be said for the suggestion that prehistoric times came to an end with the introduction of Christianity and written documents, or even continued to the middle of the eleventh century.

These changes, omissions, and additions in the recent development of prehistoric studies require a revision of nomenclature which might as a starting-point be based upon the distinction marked by Elliot Smith between Palæanthropic and Neanthropic man. While the former epoch is at present in a state of flux which precludes further subdivision, the latter falls naturally into two phases: the hunting and collecting age, and the second a cultivating age or the corn age, which is in turn divisible into four main periods. The first is conspicuous for the spread of cultivation, the second was a period of invasions, the third, the medieval period or age of faith, and the last the modern period or the machine age.

Stratigraphy, typology, the study of the distribution of cultural elements, more especially with the aid of distribution maps, each by its appropriate method and argument, has made and will continue to make specific contributions to prehistoric studies.

In the past, archæologists were wont to focus their attention on flints, potsherds or works of art —always on material objects, regardless of the men who made them. Younger investigators, and some of the veterans too, are now realizing that the human element is all-important. We are engaged in fitting together a gigantic jig-saw puzzle, of which many of the pieces are missing. To solve this gigantic puzzle—not one puzzle only, but a series—a picture of each succeeding age is needed, and ultimately an absolutely continuous series, like a roll of film, giving a moving picture of the progress of mankind. Then, if even only a part of our considerable task has been performed, we shall be in a better position to achieve that new orientation in world affairs for which many of the greatest thinkers of to-day are striving.

THE CENTRAL REGISTER

READERS of NATURE will recall several references during the past year or so to the work of the Central Register set up by the Ministry of Labour and National Service. A survey of the position of the Register as a whole appeared in NATURE of February 3, 1940, p. 176.

The Central Register has now been working for more than a year, and up to the end of October had made 9,016 placings of persons from the Register in Government Departments and other organizations engaged on work of national importance. The number of placings of scientific men of all kinds, including industrial chemists but not engineers, is 1,469.

In June last, the Select Committee on National Expenditure examined the Central Register and issued a report upon it. The report emphasized that the Central Register was an essential part of the organization of the national effort and was not, as was often supposed, an employment-finding agency; its function, as the Committee expressed it, was not to find jobs for men but to find men for jobs. The Committee noted that the chief use of the Register had been by Government departments and such bodies as Chatham House and the British Council, and that little use had been made of the Register by industry. The Committee recommended, therefore, that steps should be taken to encourage employers in the vital war industries to make greater use of the Register. The Committee referred to a widespread belief that Government Departments had not followed the Government's declared policy that the Central Register should normally be the sole medium for the recruitment of temporary staff of the standard of the Central Register. It declared that this belief was mistaken, and that departments in general had used the Central Register, exceptions to the rule being confined to the most part to the earlier stages of the War.

At the same time, the Committee expressed strongly its conviction that the position of the Central Register as the sole agent for recruiting higher personnel to Government Departments should be fully maintained, except where the urgency of any requirement of special qualifications justified an exception to the rule. The Committee further examined the criticism that there was delay in filling appointments through the Central Register, and stated in its report that this criticism had been examined and found unjustified. Some orders had been filled within a few hours, while the average time taken by the Register in making submission was between six and eight days. This period included, generally, consultation with the appropriate panel and inquiring whether the volunteer was available and willing to be considered for the post in question and whether his existing employer had any observations to offer. The Committee stated that it had visited the Register and was of the opinion that the present staff should be adequate to cope with the much greater use of the then 97,000 names on the Register which it desired. The Committee also placed on record the appreciation of the amount of voluntary effort which leading members of the professions had given to the Central Register.

Shortly after the report of the Parliamentary Economy Committee had been published, steps were taken for the compulsory registration of certain categories of persons on the Central Register where the demand was considerable. The Specified Classes of Persons (Registration) Order required qualified engineers, engineering scientists, chemists and physicists to enrol with the Central Register if they had not already done so. The result of this compulsory registration order has been to bring the total of names on the Central Register to nearly 200,000. The number of chemists who were registered as a result of the compulsory order was 5,954, the number of physicists 1,175, and the number of engineering scientists 226. These numbers are, of course, additional to those already enrolled on the Register.

Of special interest is the re-organization of the Central Register Branch which took place about this time under the control of Mr. O. V. Guy, who has been temporarily seconded from the Cambridge University Appointments Board to become an Assistant Secretary at the Ministry of Labour and National Service. The increase in the pace of the war effort, the wide powers given to the Minister of Labour and National Service under the Emergency Powers Act, and the compulsory registration of persons with technical qualifications referred to above had put additional responsibilities on the Central Register, and it was thought desirable to secure a greater understanding of the demands of the ordering Departments on one hand, and on the other hand to have a greater degree of specialization in the work of selecting candidates and handling problems of the best utilization of people on the Register. With this in mind a number of qualified scientific and technical officers were added to the staff of the Central Register. It was further thought necessary to bring the Register into closer relation with the general employment policy of the Ministry.

As a result of these considerations the Central Register was attached to the Employment Department of the Ministry of Labour and National Service, and arrangements were made for Mr. Guy to attend regularly the sittings of the Labour Supply Board. The Register was divided into seven sections, two non-technical and five technical sections. The five technical sections were placed in the charge of qualified technical men as follows: civil engineers, architects and surveyors under Mr. G. E. Forward (recently on the staff of Messrs. Howard Humphreys and Sons); mechanical engineers under Mr. J. C. Orkney (seconded from his post as lecturer in engineering at the University of Aberdeen); electrical engineers under Mr. A. L. Fielding (seconded from the post of advisory and inspecting engineer with the Agent General for the Government of New South Wales); chemists, industrial and pure, under Prof. W. Wardlaw (seconded from his post as professor of physical chemistry at Birkbeck College); all other scientific workers, including mathematicians, under Dr. C. P. Snow, fellow and tutor of Christ's College, Cambridge). Among the duties of Dr. Snow will be that of examining means of utilizing on branches of scientific work in which war-time demands are great, the services of men whose secondary rather than their primary qualification fits them for such work. Thus a number of biologists have been appointed recently to posts making use of their aptitude for physics. The seven sections are co-ordinated by Mr. H. R. Whiteman, a deputy divisional controller of the Ministry, who has been transferred to the Central Register to replace Mr. F. Gent on his retirement.

The new organization has already shown an improvement on the old. The technical heads of sections make better contact with the Service and Supply Departments from their more intimate knowledge of the problems at issue. This allows orders to be handled with a greater understanding than before. Meantime, the advisory machinery has continued to operate fully, and questions concerning the age of reservation, and supply and demand of qualified technical people of all kinds have come before the committees.

It is worth noting also that, of the members of the Scientific Advisory Committee under the chairmanship of Lord Hankey, all but one are members of the advisory machinery of the Central Register. This arrangement will avoid any overlapping of function between Lord Hankey's Committee and the Central Register, and enable the problem of supplying the requisite personnel for research to be closely linked with the development of research, and with the problems of the application of science to the war effort which Lord Hankey's Committee is considering.

In conclusion, it may be of interest to refer to the Central Register of Aliens, which at present contains 3,400 names of qualified professional men such as engineers, many of whom are immediately suitable for employment. In connexion with the steps being taken by the Government to secure that use is made where possible of the services of friendly disposed aliens in the prosecution of the War, Mr. Bevin set up an International Labour Branch to co-ordinate questions of the employment of aliens. The Central Register of Aliens has accordingly been transferred from the Central Register to the International Labour Branch, where in common with other problems of the employment of aliens it will be in the charge of Mr. T. T. Scott, late of the International Labour Office at Geneva. Prof. J. A. Davies, of King's College, University of London, has joined the International Labour Branch as a technical officer appointed to assist in finding ways for the utilization of the services of aliens.

Security restrictions have so far hampered the placing of friendly aliens in employment, but with the increasing demands of war industry, and the encouragement by the Government of the employment of approved aliens, a wider use of this Register can be expected.

KINETICS OF CONTACT CATALYSTS AND THE INDUSTRIAL BACKGROUND*

By PROF. HUGH STOTT TAYLOR, F.R.S.,
PRINCETON UNIVERSITY

IT is a tragedy of the efforts of the student of chemical reactions at surfaces, in these closing decades of the two centuries of service to culture and civilization that the University of Pennsylvania is now celebrating, that the finest flowers of the effort should have synchronized with, and been made subservient to, the international tragedy of 1914–1918 and that which now burdens the human race. It was not mere accident that, in the decade preceding the first Great War, out of the fundamental researches of Sabatier on the capacity of nickel and other metals to induce the combination of hydrogen with unsaturated substances, there emerged the answer to the famous query of Napoleon to Frenchmen of science one hundred years earlier as to the possibility, in a blockaded country, of converting liquid fats into the solid fats necessary for the production of margarine and of soaps. It was a proud boast of an English technician in 1919 that success had been attained in converting fifth-grade whale oil into edible fats in the last years of the first World War. It cannot be chance alone that the industrialization of Haber's researches on the fixation of atmospheric nitrogen and the production of the ammonia necessary for fertilizers and explosives should have been achieved on the eve of that same war which found Germany cut off, by British sea-power, from the only hitherto available source of fixed nitrogen, the nitrate deposits of Chile. These processes demanded in their turn cheaper sources of hydrogen. This was achieved by new processes of formation at catalytic surfaces, and put to use for the filling of those now archaic 'sausage balloons' that served as observation posts in the battle lines of Flanders. To-day the hydrogen is used in 'barrage balloons' employed in defence against the attacks of invading bombers.

Two decades of 'progress' demanded the solution of new problems for the coming new war. The mechanization of transport has profoundly modified the technique of modern warfare. The present distribution of sea-power compelled a blockaded country to ensure for herself either accessibility to the necessary raw materials of transport such as oil and rubber, or alternatively so to shape her technical development as to ensure the production of such materials synthetically from raw materials available within the blockaded area. Within Germany during the last years there have been developed, by means of reactions at surfaces, methods of converting coal into high-quality aviation gasoline and synthetic rubber materials which have gone far towards making that country independent of supplies from abroad. Similarly, her need for fats, mitigated in part by her conquests of the present year, demanded the replacement of the fats used in soap manufacture by synthetic detergents and the development of methods for the conversion of available raw materials into synthetic fatty acids. Marked progress has been achieved in these directions.

Even in the case of countries open to the available resources of Nature, it has been found that Nature does not always produce the most highly desirable forms of the materials to be consumed. Petroleum supplies an excellent example of such a situation. In the early days of the automobile,

* A paper at a symposium on "Chemical Kinetics" delivered on September 17 during the Bicentennial Conference of the University of Pennsylvania.

adequate fuels could be obtained by simple distillation of crude oil. Improvements were demanded by increasing fuel requirements, which led to the development of cracking processes for increasing gasoline fraction from a given barrel crude. The demand for increased power in the automobile, stimulated further by progress in aviation, led to the realization that certain types of gasoline molecules, notably *iso*-octane, possess fuel characteristics that far exceed those of other molecules within the range of volatility demanded by the engines in question. New problems were thus presented to the chemist; the conversion of low-grade natural products into the more valuable high-grade fuels. In the solution of these problems the catalytic chemist has made notable contributions. Catalytic methods have been developed for cracking complex petroleum molecules into simpler high-grade automobile and aviation fuels, for polymerizing or putting together the simpler hydrocarbon molecules to form molecules of high anti-knock value in the gasoline range, for adding simpler saturated molecules to unsaturated molecules to form valuable fuels, the so-called processes of catalytic alkylation; catalytic isomerization, the changing of molecules of a given configuration to other configurations more powerful in fuel characteristics; catalytic dehydrogenation, which coupled with catalytic processes of ring formation, led to the formation of aromatic fuels containing benzene, toluene and xylene. As a by-product of these latter new processes of dehydro-aromatization the petroleum industry is becoming an active competitor of the by-product coke-oven industry upon which, hitherto, we have been dependent entirely for the raw materials of the dyestuff industry, explosives and many pharmaceutical preparations.

Paralleling in intensity these developments with the more complex units of petroleum raw materials, a series of efforts has evaluated the lighter constituents of petroleum, natural gas and the cracked gases of refinery operations. Catalytic processes have been developed for the direct oxidation of ethylene at metal surfaces, notably silver surfaces, to yield ethylene oxide, itself a reagent of great value in a series of synthetic processes and the intermediate in the production of ethylene glycol, a product now required on a tonnage basis for anti-freeze solutions. Propylene, the next higher unsaturated olefinic hydrocarbon, is, by reason of a newly developed process, the raw material for synthetic production of glycerine available at any moment when the by-product glycerine of soap manufacture becomes inadequate to meet the demands. Butene, a four-carbon atom olefine, yields by further catalytic removal of hydrogen the butadiene which is the starting material for the synthetic rubbers of the 'Buna'-types developed in Germany. There, due to lack of petroleum, coal is the raw material and the production of butadiene occurs via the formation of calcium carbide and acetylene. That butadiene, under the influence of metallic sodium, would polymerize to a rubber-like material has been known since the end of the last century. It was such materials which were employed as rubber substitutes by the Germans in the latter phases of the War of 1914–18.

The progress achieved in the recent researches on these materials arises from the discovery that 'cross-polymerization', the introduction of other molecules into the growing unit, rubber, like the plastics, cellulose, starch, etc., is 'macro-molecular', that is, composed of large numbers of constituent units combined with each other into a structural pattern conferring on the mass its particular characteristics. The newer synthetic rubbers build into the growing butadiene polymer such other materials as styrene and acrylic nitrile, with the result that products having abrasion characteristics and resistance to oxidation, and therefore to deterioration, from 5 to 30 per cent better than the best natural rubbers have been produced. Superior characteristics over the natural products also obtain in the case of such special products as 'neo-rene' and 'thiokol' which, in addition to their carbon and hydrogen constituents, contain also chlorine and sulphur respectively, thus deviating markedly in constitution from the natural product, and possessing properties which for certain purposes render them more valuable than the natural product.

In the field of plastics also the chemistry of reactions at surfaces is making notable contributions. These materials have almost endless uses and possibilities, alike for peace-time and war. They can be used as substitutes for metals and for glass. Optical instruments, aeroplane parts, possibly even as impregnating material for plywood aeroplane wings, are among their immediate uses in the era of defence now upon the United States. Solvents for plastics, ethers, alcohols and esters are allied materials that the catalytic chemist is contributing. From these researches also come the newer synthetic fibres of which 'nylon', as a material superior in many characteristics to silk, is now in large-scale production. The raw materials from which they are made, coal, limestone, petroleum, water and air, require the chemistry of reactions at surfaces for the transformations that ultimately yield the desired products.

Side by side with the intensive industrial developments here outlined, there has grown up also in industrial research, Government and university laboratories a broad programme of theoretical study in this field. Upon the pioneering investigations of Langmuir has been built a body of theoretical fundamental knowledge, the major contributions to which have come from American laboratories, and with the aid of which a more rapid and certain approach to the solution of problems of industry can be achieved. Langmuir recognized that the seat of chemical change at surfaces was a layer of absorbed gas one molecule thick associated with the surface by chemical forces. The heterogeneity of catalytic surfaces was then recognized and its importance in the interpretation of the great sensitivity of surfaces to poisons became understood. This concept led also to an understanding of the phenomenon of promoter action, whereby with suitable added material the efficiency of a given quantity of catalyst material could be enormously enhanced. The quantitative extent of the surface could be increased and its quality multiplied. Later researches revealed that two types of association of a gas with a surface, one physical and the other chemical, could obtain, and that the operating temperatures determined which type of interaction occurred. With different surfaces, different temperature ranges could be employed. The range of catalytic materials and the temperature ranges in which they operate were correspondingly expanded. With the advent of isotope separations, signalized by Urey's discovery of heavy hydrogen, followed by heavy oxygen, carbon, nitrogen and sulphur, new tools became available for the study of the associations with surfaces involved in catalytic changes.

To-day the analysis is going yet deeper. With the modern tools of X-ray and electron diffraction, the catalytic chemist is examining the activities of individual faces of crystals and is demonstrating that the geometrical configurations characteristic of particular faces are more favourable to the activation of reactants than are other faces. As a consequence, methods can be developed to produce the desired crystal faces in preponderant amount. Twenty-five years ago, the science of catalysis was almost purely empirical, dependent entirely on trial and error; it has now become a highly refined scientific study, rich in possibilities for applied science and in joyous endeavour for the fundamental scientist.

OBITUARY

Prof. H. Rosenberg

PROF. H. ROSENBERG, director of the University Observatory at Istanbul, Turkey, whose death has just been announced, was one of the pioneer workers in modern astrophysics.

It was in 1914 that Rosenberg completed a fundamental paper on the photographic investigation of the intensity distribution in star spectra. Using Planck's law, and for calibration the standard star α Aquilæ and the sun, he was led to a preliminary series of seventy stellar temperatures; it was the first of its kind, as previous temperature work by Wilsing–Scheiner–Muench was carried out exclusively by visual spectrophotometry. The comparative study of the differences between these two series later gave rise to a number of fruitful investigations concerning the deviations of stellar radiations from black body radiation.

In August 1913 Rosenberg announced at the Hamburg meeting of the Astronomische Gesellschaft the successful introduction of the potassium photocell into stellar photometry. At the same time as Rosenberg, but independently, work along similar lines was carried out by P. Guthnick, while the selenium cell has been used most skilfully by J. Stebbins in America. In view of the prominent part which both spectrophotometry and photo-electric photometry play in modern researches, Rosenberg's influence will not be under-estimated, even without going into detail of all his other notable contributions to astronomy. These were concerned mainly with variable stars, the formation of photographic star images, the scale of effective wave-lengths, the removal of instrumental errors; furthermore, the successful construction of a new polarization photometer and its application to surface brightness measurements on the moon (1921), of an electromicrophotometer (1925), and of a photographic double filter giving simultaneously two close star images, in blue and yellow (1936).

Most of his earlier work was carried out by Rosenberg at his private observatory at Oesterberg near the University of Tübingen, where he held a chair before his appointment, in 1925, as director of the Kiel Observatory, in succession to P. Harzer. When the Nazi regime commenced, Rosenberg was forced for 'racial reasons' to resign; he worked for two years in the United States under Prof. Otto Struve at the Yerkes Observatory at Williams Bay, and three years ago became the new director of the Observatory at Istanbul, succeeding Prof. E. F. Freundlich. The breakdown of scientific culture in Nazi-Germany prevented him from completing some of his plans; one of these has already been discussed by the present writer in NATURE (**142**, 496; 1938); it was the planning of a new astrophysical handbook which, in 1938 (after Rosenberg's departure but mainly with the team of his selected collaborators) was edited in a masterly way by Prof. Bengt Strömgren of Copenhagen.

NEWS AND VIEWS

Dr. F. M. Lea

THE administrators of the Beilby Memorial Fund have announced an award of a hundred guineas to Dr. Frederick Measham Lea in recognition of his researches on the constitution of silicate systems and the chemistry of cement in its physico-chemical aspects. Dr. Lea was educated at King Edward VI School, Birmingham, and after war service during 1918–19, entered the University of Birmingham, where he gained the Frankland Prize for practical chemistry, and graduated B.Sc. with first class honours in 1921, proceeding to M.Sc. in 1922 and D.Sc. in 1935. He was elected an associate of the Institute of Chemistry in 1922 and a fellow in 1936. During 1922–25, Dr. Lea was attached to the Admiralty Engineering Laboratory. Since 1925, except during 1928–29 when he was guest research associate at the Bureau of Standards, Washington, he has been a member of the staff of the Building Research Station, Department of Scientific and Industrial Research, where he now holds the position of principal scientific officer. Dr. Lea was a member of the Official British Delegation to the World Power Conference and Second International Congress on Large Dams held at Washington in 1936 and has also been a British representative on the International Committee on Special Cements, and honorary secretary of the corresponding British Committee. He has also served on a number of sub-committees of the Research Committee of the Institution of Civil Engineers and is at the present time chairman of the Roads and Building Materials Group of the Society of Chemical Industry.

Total War and Spiritual Values

As winter draws on, the 'New Order' of the Nazi régime relentlessly imposes upon the subjugated peoples of Europe conditions comparable only with those of the Middle Ages, when the peasantry had famine and pestilence ever imminent at their doors, following in the train of the wars waged by their overlords. The aims and methods of the Nazis are a grim commentary on the glorious renaissance in arts, science and letters which in Germany followed the close of the Napoleonic Wars, when a united and freedom-loving German people had helped to throw off the yoke of another dictator. Whatever may be the loss of life and property inflicted by recent activities of the Nazi air arm, nothing so clearly reveals the intention with which the Nazis have entered upon this War as the gutted Bristol Museum and shattered great hall of the University of Bristol, or the ruins of St. Michael's, the great cathedral church which for centuries has been the centre and a symbol of the corporate life of the city of Coventry. In destroying these and other edifices of a like character throughout Britain, their aim is not to secure military or material advantage, but to strike a deliberate blow at vital sources of spiritual and intellectual freedom.

That acts such as those mentioned above have their place in settled policy and are not the random and inevitable consequences of warfare from the air is made clearer as the concomitants of the political and economic 'New Order' are disclosed. Since the establishment of the customs and monetary union between the Reich and the Protectorates of Bohemia and Moravia, it is reported in *The Times*, persecution of the Czechs has been intensified. Nearly four hundred Catholic priests have been arrested, while the dismissal of the rectors and deans of the Czech universities is, not unreasonably, taken as an indication that it is not intended to reopen these institutions, which last year were ordered to close for a period of three years. The purpose of this action was indeed revealed by the Secretary of State, K. H. Frank, who when asked by a deputation to reopen the universities, replied that in the event of a German victory "elementary schools will be enough for you". The intention of completely subordinating all intellectual activity to the expression of views officially approved is even more nakedly exposed in the exhortations addressed to Czech authors to support the 'New Order' and to earn handsome royalties. They are, it is said, free to write what they will, so long as they undertake not to offend Germany. In like manner in Holland, all text-books containing any criticism of Germany are suppressed; and now the universities themselves are threatened with closures on account of the attitude of their students.

Malayan Nature Society and Journal

A MALAYAN Nature Society has recently been inaugurated. Although the calling of an opening general meeting was found impracticable, officers have already been elected, in order to secure the inception of the Society. They are: *President*, Mr. E. O. Shebbeare, Game Department, Kuala Lumpur; *Secretary and Treasurer*, Mr. A. T. Edgar, Suffolk Estate, Sitiawan, Perak; *Editor*, Mrs. G. Le Mare, 254 Upper Stephens Road, Taiping. There is a number of keen naturalists in Malaya, and these should form a sound nucleus for the Society, which will doubtless do much towards promoting the study of the natural history of such a rich area and encouraging new arrivals to Malaya. The Society hopes later to inaugurate informal State or Settlement branches—a sound scheme in an area where natural history, anthropology and ethnology, etc., offer such diverse fields of study and observation.

The first number of the *Malayan Nature Journal* (1, No. 1, 1–27; August 1940) has just reached us. It is well printed on good paper, and attractively illustrated by three full-page, twenty-two half-page, and six quarter-page photographs. An article by E. J. H. Berwick on the long-tailed tailor-bird contains some beautiful illustrations of the male and female and of their uncommon type of nest. In the same paper is described an unusual shama's nest. Observations from a 'hide' are described and details of the structure of the nest are given. R. O. Noone describes caves and some cave formations, and submits eight photographs of unusual interest, especially one of strange calcite growths which are even now not satisfactorily explained. The president, E. O. Shebbeare, gives a short but interesting account of an elephant trek. In a paper on Malayan bears, A. H. Fetherstonhaugh describes chiefly two bears in captivity. The illustrations of these are particularly fascinating. A few observations are also made on bears in their native jungles. G. S. Ogilvie presents a descriptive account of the 'Che Wong', a little-known primitive tribe from an area well known for its diversity of primitive peoples. This account is also supported by well-produced photographs. The *Journal* has certainly made a good start, and we wish it success and much support. The annual subscription is six dollars (single numbers, two dollars). A few spare copies of the first number are available at Malaya House (Mr. G. E. Cator), 57 Trafalgar Square, London, W.C.2.

Dried Onions

THE trade in dried onions developed after the War of 1914–18, and there is now a big demand for this material on the Continent (*Bull. Imp. Inst.*, 38, No. 3; 1940). In Great Britain the quantity used in 1939 was only about 400 tons, but in view of the scarcity of the fresh vegetable an increase may be expected. Hitherto, supplies to Great Britain have come from southern Europe; but as these are no longer available it is suggested that Empire sources be developed. The method of preparing the onions is briefly as follows: The bulbs are peeled by hand and cut into thin slices which may then be immersed in a 5 per cent salt solution for 3–5 minutes to prevent discoloration. Drying is carried out on trays in tunnel driers for about 5–10 hours, the slices being kept turned to hasten the process. The temperature should not be allowed to rise above 140° F., or flavour is lost and the slices darken.

The finished material should be dry and crisp with a moisture content of 5–7 per cent. Sun drying is said to give less satisfactory results than artificial drying. The dried product is usually shipped in tin-lined cases of 1 or 2 cwt. each, the material fetching between 65–70 shillings per cwt. before the War, but by August 1940 it was worth 150 shillings per cwt. in London. On an average, one ton of the dried material represents about 10 tons of fresh onions. The Imperial Institute, London, would be glad to receive samples of dried onions from Empire sources with the view of submitting them to the trade for a report on their market possibilities.

Mineral Products of the British Empire and U.S.A.

THE possibility of a joint control of essential minerals and other natural products by the United States and the British Empire as a means of preventing future wars or of curtailing their duration is raised again by Dr. William Cullen in a paper contributed to *Chemistry and Industry* of November 30. Dr. Cullen suggests that the great distance which public opinion in the United States and elsewhere has travelled in the past few months brings a mineral sanction within the bounds of possibility. He points out that apart from food the two most essential materials in modern warfare are steel and oil. Good steel cannot be made without manganese, and in all Europe there is no appreciable amount of manganese. Even with Poland and Rumania, Europe is very badly off for mineral oil. The United States of America and the British Commonwealth control 75 per cent of the world's reserves of economic minerals, and if the United States and the British agreed by treaty that no aggressor nation should be supplied with essential metals and minerals, and that during peace, steps should be taken to prevent the accumulation of reserves by any other nation, it would be impossible for any aggressors to carry on a war for any lengthened period. With the pronounced change in American opinion, Sir Thomas Holland may see the fruition of all his labours in this field.

New World Populations and the Future

IN another column of this issue of NATURE (see p. 783), certain figures are extracted from a comparative study by Prof. Raymond Pearl of the populations of the New World and the Old. After making allowance for any inaccuracies and uncertainties in the data upon which his study is based, he arrives at the conclusion that, when they are examined in respect of certain criteria, such as density of population in a given unit of space, rate of growth, age distribution and the like, the populations of the New World, as contrasted with those of the Old, have in a biological sense all the characteristics of a young and vigorous organism, and that this fact carries with it certain social and psychological implications. Thus he points out that the relatively low figure for the density of population implies freedom of movement and expansion in settlement, the vigour indicated by the rate of increase of population and a higher birth-rate affords freer play for the forces of natural selection and the production of a virile and healthy stock, while the higher proportion of the population of pre-reproductive age holds out promise of a bold and enterprising outlook as against the pessimistic and despondent attitude of mind in a community such as that of the Old World, in which no less than one fifth of the whole has passed the active age of production.

Taken on the basis of an abstraction, Prof. Pearl's analysis is impressive; but it has the weakness of all abstractions that it presents only a certain aspect, or certain aspects of reality. This he admits when he feels constrained to pass by the criterion of 'quality', on the ground that it is difficult or impossible to apply with scientific accuracy. He finds that quality, however, as the eugenist would maintain, does open the way in one direction at least in which Old World populations may seek to redress the balance against them. Prof. Pearl himself, indeed, directs attention to certain dangers in the future of the post-War world to which his figures point as arising out of the very advantages which America enjoys. While, he holds, the populations of the western hemisphere are in a relatively much more favourable position biologically and demographically than are those of the eastern hemisphere, the close of the War will bring such pressure on the Americans to take immigrants as has never before been exerted. Their countries will be asked to share those acres that are still so sparsely populated. Before that happens, Prof. Pearl maintains that sound population policies scientifically conceived and administered, "should determine the relationship . . . between the numbers of the people and the area of the good earth on which they live, upon which prosperity and happiness finally depend". On the assumption that Prof. Pearl's forecast will be justified by the event, the question is one upon which the decision of the people of America, as most intimately and vitally concerned, will be final; but the problem opens up a vast field for joint investigation and effective co-operation for the general good of mankind between the peoples of the Old World and the New.

Sir Theodore Turquet de Mayerne

IN a richly documented paper (*Proc. Huguenot Soc. Lond.*, **16**, 301; 1940) on Sir Theodore Turquet de Mayerne, royal physician and writer, Miss Irene Scoloudi states that he was born at Geneva on September 28, 1573. He received his medical education at Heidelberg and Montpellier, where he studied under Riverius, who became physician to the Court of Henri IV, and qualified in 1596. He afterwards moved to Paris, where he soon became well known. In 1600 he was appointed district physician of Paris and physician in ordinary to Henri IV. Six years later he was invited to England, where he received the honorary degree of M.D. from the University of Oxford and was made physician to the wife of James I. In 1616 he was elected fellow of the Royal College of Physicians, and next year played a part in the formation of the Society of Apothecaries. In 1618 he was deputed by the College to write the dedication of the first Pharmacopœia to the King, by whom he was knighted in 1624. Although in his official capacity or as a medical witness he was connected with several scandals and lawsuits, such as the Overbury and Gaultier cases, he came out unscathed. He died on March 22, 1655. Mayerne is now chiefly remembered for his case reports by which he founded the practice of careful case taking. He published only two works composed entirely by himself, one being a pamphlet in reply to the French physicians with whom he quarrelled, and the other on a tour in France, Germany, Italy and Spain, which was one of the first extant French itineraries, and passed through several editions. In collaboration with Moffett he brought out a work on insects and also helped to compile a book of recipes for the Distillers' Company.

Public Health in India

ACCORDING to the annual report for 1939 of the Public Health Commission in India, the outstanding feature in that year was the large decrease in the incidence of cholera. Whereas in 1938 deaths from the disease in the Punjab numbered 5,670, in 1939 they were only 19. Improved sanitation of the villages and towns through which pilgrims pass is the most effective method of prevention, but is a slow process, and in the meantime the best practical method is anti-cholera inoculation, its compulsory enforcement being the best practical measure. Of the annual six million deaths in India a fifth or a quarter is attributed to malaria, to outbreaks of which India is everywhere subject, except in areas 5,000 ft. above sea-level and a few widely separated regions. In the large cities such as Bombay and Delhi control measures are being successfully carried out, but rural malaria is a difficult problem. The general policy of provincial authorities is to provide an adequate supply of quinine or cinchona febrifuge to popularize the use of these drugs and to provide for their distribution by travelling dispensaries. The greatest sources of danger from yellow fever lies in the air-traffic passing through infected areas in Africa. Under Government rules any person who has been in a yellow fever area is forbidden to enter British India until nine days after exposure, unless he has been inoculated or is protected by a previous attack.

Fuel Analytical Methods

THE analysis of solid fuels, as befitting its technical importance, is described widely in technical literature. The treatment, usually confined to the proximate analysis, is so familiar as to give an appearance of simplicity which is not in fact warranted. Many pitfalls occur, especially when somewhat abnormal fuels are in question. This emphasizes the need for specification when commercial transactions are involved and has led to the production of British Standard Specifications. Even these can only prescribe methods to secure uniformity of procedure, and there is a need for a critical treatment of fuel analytical methods.

The Fuel Research Board is well qualified to undertake this task because in the physical and chemical survey of coal its staff examines every kind of coal found in Great Britain, and many elsewhere. Its experience is embodied in "Methods of Analysis of Coal and Coke" Paper No. 44 of the Physical and Chemical Survey of Coal Resources (H.M. Stationery Office). The methods given are not always identical with those in the B.S.I. Specification and at times include refinements unlikely to be used in technical practice. These elaborations may, however, at any time be required. Most of the possible components of coal are mentioned. It is worthy of comment that in a book of this character it is still considered sufficient to limit the treatment of 'ash' to a determination of the residue on ignition—composition, fusibility, physical structure and density being ignored.

Beetle Pests of Furniture

UNDER the title of "Beetles Injurious to Timber and Furniture" a bulletin was issued in October last by the Department of Scientific and Industrial Research which gives an account of the damage and losses caused by these insects. It is based on the text of Bulletin 9 of the Forestry Commission by Prof. J. W. Munro, which is now out of print. The new bulletin, which is a revision and amplification of its predecessor, has been written by Dr. R. C. Fisher in consultation with Prof. Munro and includes the results of recent investigation. The longhorn and pinhole borers are essentially forest insects: they attack recently felled timber, but abandon it during the drying and seasoning. The powder-post and furniture beetles are enemies of seasoned woods, the former abounding in timber yards and the latter attacking antique furniture and the structural timbers of old buildings. The losses occasioned by these different classes of beetles are often very great, and the present bulletin gives a clear and well-illustrated account of how to avoid or reduce the damage by the adoption of preventive and remedial measures. The publication, which is Forest Products Research Bulletin No. 19, is obtainable from His Majesty's Stationery Office, or through any bookseller, price 1*s*. 6*d*. net.

Evolution of Weapon Types and Design

IN the *Journal of the Franklin Institute* of October, Brigadier-General Earl McFarland, of the United States, has published a paper on the trend in weapon types and design. He first gives a sketch of the story of man's effort to adapt scientific principles to self-defence. Each of the great civilizations of history developed something new in the art of warfare. The epoch-making invention of gunpowder by the Chinese is placed first in the list. The period since the Napoleonic wars has seen the introduction of steel and its application to gun manufacture and projectiles. The development of chemistry has led to the manufacture of propellants and explosives exceeding by many times the effectiveness of the cruder preparations of a century ago. The development of military weapons during the last three generations has been greater than during the entire previous period of recorded history. The invention of the petrol engine had a revolutionary effect vastly increasing both the tactical and strategic mobility on the ground and in the air.

The United States Congress in 1794 passed an Act which provided for the establishment of a system of Government-owned shops for the manufacture of muskets. At the Springfield Armory, Massachusetts, the musket or rifle has been produced continuously for 144 years. The Frankford Arsenal, organized only twenty years later than Springfield Armory, has carried on without interruption, in war and in peace, the manufacture of ball, armour-piercing and tracer ammunition for rifles and machine-guns; it is now manufacturing the mechanical time fuse. American troops are being armed with the semi-automatic shoulder rifle, officially known as U.S. Rifle, Calibre ·30 Ml., but often referred to as the Garand rifle, from J. C. Garand, an ordnance engineer of Springfield Armory, who was mainly responsible for its design and development. The trend in rifle design is toward the type which demands the least time of training and which gives the greatest number of aimed shots per minute with the minimum fatigue to the firer. At the present moment, a contest is going on between the anti-tank gun and tank armour. The gun is sure to win in the long run.

Interior Lighting and Decoration by Fluorescence

NEW effects in interior decoration have been obtained recently by using fluorescent paints and ultra-violet lamps. In the Hawaii Theatre opened in the early summer in Hollywood the whole of the walls and ceilings have been covered with fluorescent paint. When cinema pictures are shown the ultra-violet lamps are switched on, but no other illumination is used. The whole auditorium then seems to be bathed in 'shadowless moonlight' and the walls appear to have receded. The audience has the impression of sitting under a deeply luminous blue Hawaiian night sky with brightly glowing stars. In earlier attempts at interior decoration by fluorescence, blues and greens preponderated to give only a limited range of colours. A sufficient number of paints, twelve in all, has now been developed so that landscapes can be painted on the walls. A panel of Mount Manua Loa spouting fire and smoke gives the impression of many miles in distance. The fluorescent materials can be had as either solid paints or transparent varnishes. White fluorescence is obtained by applying two complementary colours, such as a red and a green, so that at a distance from the surface the light mixes well enough to give an effect of white light. The transparent varnishes are invisible in ordinary light.

Advertising signs have been made to give one picture in natural light and a second picture in filtered ultra-violet—'black light'. Carpets have also been impregnated with fluorescent substances. Details of all the products can be had from Conti-Glo Paint, Continental Lithograph Corp., 952 East 72nd Street, Cleveland, Ohio. The literature supplied is concerned with the decorative and third-dimensional effects. As, however, the use of ultra-violet light is an essential part of the scheme it would appear that, by extending the range of the ultra-violet sources, air sterilization could also be combined with the new decorative effects. In hospitals at night, where low-level illumination is needed, the patients could have the beneficial effects of air sterilization together with rest under a "deeply luminous blue Hawaiian night sky".

Testing Steel Rails

A DESCRIPTION is given in the *Electrical Review* of November 22 of the method developed by Sperry Products, Inc., Hoboken, New Jersey, U.S.A., for examining steel running rails of railways *in situ* for internal defects. A recording car is used, and operation is based on the fact that any internal discontinuity in a metal bar creates an area of high resistance to the flow of direct current; consequently a difference of potential will occur at the site of the internal flaw. Indicating currents are conveyed to the track rails by brush holders attached behind the front bogie and underneath the frame of the rear bogie of the coach. A current of about 1,500 amp. up to 8 volts is injected for pre-energizing the rails to ensure uniformity of molecular arrangement prior to the introduction of the detecting current just in front of the two pairs of searching coils. This precaution is necessary because running rails are generally magnetized by the normal effect of the earth's field, augmented by vibration due to the pounding of passing train wheels.

The magnetic poles strongly formed in this way are of two kinds; the effects of the superficial ones on the surface of the rail can be avoided by the use of suitable brush gear for conveying the test current to the rails, while those within the railhead can be overcome by raising the detective current density to 275 amp. per sq. in., which means feeding 4,000 amp. to each rail at up to 4 volts. The testing currents are furnished by a petrol engine with gear-box and multiple belt pulley which drives the main current (8,000 amp.) and auxiliary (pre-energizing) generators and a 200-volt exciter mounted together in the car. The recording tape moves at 0·025 in. per ft. of car travel; the recording car travels at seven miles per hour when fault detecting. It is reported that in seven months this year 597,000 miles of track, tested in this way, revealed 304,000 defective rails.

Movable Electric Generating Stations

THE Commissariat of the Building Industry of the U.S.S.R. is constructing 1,000 movable electric generating stations for use in timber camps and on railway construction jobs. The movable generating stations will be of various capacities, beginning with the smallest, of 2·5 kw., which will be used by railway maintenance men. Generators of this capacity will be installed on hand-carts and moved about from place to place as required. Electric generating stations of 30 kw. capacity will be fitted on the running-boards of automobiles and worked by the motor engine. A novel feature of the electric power stations of 50 kw. capacity will be a gas generator, instead of the ordinary Diesel engine, which will effect a considerable saving of fuel.

New Seismographs for Boulder Dam

AN ambitious, though necessary, seismological programme is being undertaken in the neighbourhood of the Great Boulder Dam (*Earthquake Notes*, **22**, Nos. 1 and 2, September 1940). A Wood-Anderson seismograph has been operating for several years at Boulder City, and two Neumann-Labarre vibration meters are temporarily installed at Overton, Nevada. The seismograph buildings at Pierce Ferry on Lake Mead are almost ready to house the temporary Coast and Geodetic Survey vibration meters. The construction of permanent Benioff instruments recording on 35-mm. motion picture film for all three stations is nearing completion. Four records, two horizontal, one vertical and one 'time record', will be made simultaneously on one drum. The 'time record' will be a film on which radio time signals will be recorded at regular intervals several times each day in addition to the regular chronometer time marks. Through the use of a reading microscope with two-way micrometer control, it will be possible to read time from the record to the nearest hundredth of a second and to measure amplitude to corresponding precision. Another feature of the seismographs is a second vertical seismometer used to control relays for intensifying the recording light at times of recording strong seismic disturbances.

Earthquake in Chile

ON the basis of instrumental reports from fourteen seismographic observatories, the United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentre of the earthquake of October 11, 1940, to be provisionally at latitude 45° S., longitude 73° W. This is on the mainland of Chile opposite the Chanos Archipelago and north of Taitao Peninsula. It has been the scene of many small earthquakes and earth tremors in the past.

Announcements

PROF. HUGO ILTIS, formerly director of the Mendel Museum in Brno, has been appointed professor of biology in Mary Washington College, Fredericksburg, Virginia.

PROF. TH. DOBZHANSKY, formerly professor of genetics in the California Institute of Technology, Pasadena, has been appointed professor of zoology in Columbia University, New York.

DR. A. C. SMITH, formerly associate curator of the Herbarium, New York Botanical Garden, has been appointed curator of the Herbarium of the Arnold Arboretum, of Harvard University.

THE following appointments in the Colonial Service have recently been made: J. E. Hardy, chief plant protection officer, Palestine; J. K. H. Wilde, veterinary research officer, Tanganyika.

AT a Congregation of the Senate of the University of Cambridge on December 9, degrees of M.A. *honoris causa* were conferred on Prof. A. M. Carr-Saunders, director of the London School of Economics and Political Science; Prof. F. L. Hopwood, professor of physics in the University of London (St. Bartholomew's Hospital Medical College); and Prof. A. E. Richardson, professor of architecture in University College, London.

THE British Museum (Natural History) has recently published three additions to the series of "Economic Leaflets". These are No. 4, "Psocids, Book Lice, Dust Lice, etc."; No. 5, "Crickets"; and No. 6, "Plaster Beetles". Each type of insect dealt with is clearly illustrated and an account is given of its habits, the injuries that it may cause and the best means of controlling it. The leaflets are sold at the British Museum, Cromwell Road, London, S.W.7, price 1*d*. each for Nos. 5 and 6, and ½*d*. for No. 4.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Collisions of Neutrons with Deuterons and the Nature of Nuclear Forces

ATTEMPTS to decide the nature of the forces between elementary nuclear particles by investigation of the distribution in angle of protons projected by neutrons have so far proved fruitless. This is because the only source of neutrons, homogeneous in velocity, at present available is the D – D reaction, which yields neutrons of 2·2 mv. energy. The wave-length of these neutrons is so long compared with the range of the neutron – proton forces that only those particles which make head-on collisions are effective in the scattering. These particles give an isotropic distribution of the scattered intensity in relative co-ordinates independent of the nature of the neutron – proton force.

To obtain information more sensitive to the nature of the forces it is necessary to investigate collisions of neutrons with simple nuclear structures of dimensions comparable with the wave-length of 2·2 mv. neutrons. We have therefore carried out a detailed theoretical investigation of the collisions of neutrons with the simplest of such structures, namely, deuterons.

The interaction energy between any two nuclear particles, ij, was taken to be of the form

$$-\left[mM+hH+\left\{\tfrac{1}{2}(1-x)-h\right\}B+\tfrac{1}{2}(1+x)-m\right]Ae^{-ar_{ij}},$$

where M, H, B are the Majorana, Heisenberg and Bartlett exchange operators. x is the ratio of the force between particles of opposite spin to that between particles with the same spin and has the known value 0·6. The constants A and α were taken to be those given by Present and Rarita[1] as the ones which lead to binding energies of H^3, He^3, He^4 in best agreement with that observed. Three distinct sets of values of m and h were taken for detailed calculation:

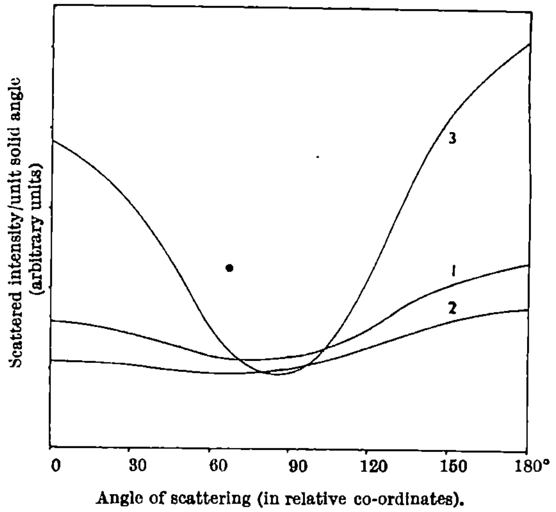
(1) Mixed exchange force.
$m = \frac{1}{4}(1 + 3x)$, $h = \frac{1}{4}(1 - 3x)$.

(2) Majorana-Heisenberg exchange force.
$m = \frac{1}{2}(1 + x)$, $h = \frac{1}{2}(1 - x)$.

(3) Ordinary force.
$m = 0$, $h = 0$.

The method employed in calculating the scattering follows that of resonating group structure introduced by Wheeler[2]. Exchange of particles is taken into account but the polarization of the deuteron by the incident neutron is neglected. The integro-differential equations involved were solved by numerical methods.

In Fig. 1 the calculated angular distribution, in relative co-ordinates, for the scattering of 1·85 mv. neutrons by deuterons is illustrated for each of the assumed types of force (1), (2) and (3). It will be seen that curve 3, corresponding to ordinary forces (case (3)), shows a much more marked variation of scattering with angle than either of the other two. The recent experiments of Barschall and Kanner[3] indicate that there is little variation in scattered intensity in the angular range of their observations (70–135°). This suggests that the fundamental nuclear forces are really of exchange type approximating to (1) or (2).



CALCULATED ANGULAR DISTRIBUTION (IN RELATIVE CO-ORDINATES) OF NEUTRONS OF 1·85 MV. ENERGY SCATTERED BY DEUTERONS.

Curve 1, assuming 'mixed' exchange forces.
" 2, " Majorana-Heisenberg exchange forces.
" 3, " 'ordinary' forces.

The evidence from the total collision area Q also points the same way. The measurements of Aoki[4] give $Q = 2{\cdot}2 \times 10^{-24}$ cm.^{2} for D–D neutrons. We find for cases (1), (2) and (3) respectively 2·25, 1·79 and $3{\cdot}37 \times 10^{-24}$ cm.^{2}, strongly favouring (1).

It thus appears that very useful evidence regarding nuclear forces can be obtained by a detailed study of neutron – deuteron collisions. It is hoped that further experimental evidence will be forthcoming.

A detailed account of the theory will be published in the *Proceedings of the Royal Society*. It would not have proved possible to complete the numerical solution of the equations involved but for a grant from the Government Grants Committee of the Royal Society, which enabled us to employ the professional services of the Scientific Computing Service.

H. S. W. MASSEY.
R. A. BUCKINGHAM.
University College,
London.
Nov. 19.

---

[1] *Phys. Rev.*, **51**, 788 (1937).

[2] *Phys. Rev.*, **52**, 1083 (1937).

[3] *Phys. Rev.*, **58**, 590 (1940).

[4] *Proc. Phys.-Math. Soc. Japan*, **21**, 232 (1939).

The Possibility of Detecting a Doubly-Charged Proton by the Photographic Method

BHABHA[1] has recently shown, on theoretical grounds, that there probably exists a proton having a double charge. Such a particle might be expected to occur in the nuclear explosions produced by cosmic rays, and it has been suggested that the most likely way of detecting it would be by examining the tracks which are found in photographic plates exposed at a high altitude.

We have here a number of Ilford 'R' plates which, by the kindness of the Rev. W. Asboe of Leh, Kashmir, we were able to place at a height of more than 18,000 ft. in the Himalayas. A full study of these plates has yet to be made, but at the suggestion of Dr. Bhabha we have examined some areas to see whether they furnish any evidence for the existence of the doubly-charged proton. The plates show large numbers of tracks, many of which are doubtless due to protons, and some hundreds of them have been measured. We conclude, however, that the resolving power of the method is insufficient to reveal the new particle, for reasons which we will briefly indicate.

In general, there are two criteria for classifying tracks of unknown origin: (*a*) total length, (*b*) mean grain spacing, *s*. The first criterion is here of little use, for we can seldom be sure that the whole path of a particle is fully recorded in the emulsion. Other causes of uncertainty in length measurements have been discussed elsewhere[2,3]. Some workers[4] have based important conclusions on the distribution of track lengths, claiming a fairly high resolving power, but this is only in special types of experiment, under controlled conditions, where the tracks are produced by known ionizing particles of one kind.

The second criterion has also been previously discussed[2,3]. The *s*-value depends on the ionizing power of the particle producing the track. It has a minimum value for α-particle tracks, since an α-particle ionizes sufficiently strongly to affect practically every grain it encounters. (Heitler[5] reports a track with three times the grain density of an α-particle track, which he interprets as due to a heavy particle of very high effective charge. This conclusion is difficult to understand, for the implication that the α-particles affect only one grain in three is contrary to previous results.) The *s*-value enables us to distinguish proton from α-particle tracks with certainty when the tracks are long, but for short tracks there is uncertainty, since the distribution curves for *s* overlap. Bhabha[1] has shown that the doubly-charged proton would have a mean ionization, for the same range, about twice that of a proton, so we may expect the mean grain spacing, in tracks of these particles, to be intermediate between the values for α-particle and proton tracks. If therefore the distribution curve of *s*, for a large number of measured tracks, were to show three well-defined peaks, it would be legitimate to interpret the middle one as evidence of the doubly-charged proton. Even in the ideal case, however, with plates containing only the tracks concerned, and free from background grains, such a group could not be distinguished unless it contained a relatively large number of tracks. The overlapping of the two end groups would entirely mask a small intermediate group.

In the present experiments the ideal conditions are far from being realized. After four months exposure to penetrating radiation, the plates contain tracks due to all kinds of ionizing particle, and the number of background grains is naturally very much greater than on unexposed plates. These grains seriously interfere with the measurements. One can seldom be confident that the end grains of a track have been correctly located, and the number of grains to be assigned to a track is often doubtful. These uncertainties necessarily decrease the resolving power. Moreover, it is to be expected that the doubly-charged proton will be relatively infrequent, so that only a small proportion of the tracks will be due to this particle. Under these conditions, it is not surprising that our values of *s* for the measured tracks are distributed almost uniformly between 1·5 μ and 4·5 μ, and give no indication of different groups of particles.

It is possible that half-tone or process plates, which have been used by some workers, may have a somewhat different resolving power, but as 'R' plates are specifically designed to have the most suitable characteristics for track recording, it is improbable that a different choice of plate would give an appreciably better result. In this particular type of experiment the lack of resolving power seems unavoidable. There are undoubtedly problems to which the method of the photographic plate can be advantageously applied; but we think it unlikely that a definite decision regarding the existence of the doubly-charged proton can be reached by this method.

H. J. TAYLOR.
D. FRASER.
V. D. DABHOLKAR.

Wilson College,
Bombay.
Sept. 28.

[1] Bhabha, *Proc. Ind. Acad. Sci.*, **11**, 347 (1940).

[2] Taylor, *Proc. Roy. Soc.*, A, **150**, 382 (1935).

[3] Taylor and Dabholkar, *Proc. Phys. Soc.*, **48**, 285 (1936).

[4] Powell, NATURE, **144**, 115 (1939); **145**, 155 (1940).

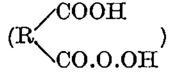
[5] Heitler, Powell and Fertel, NATURE, **144**, 283 (1939).

South African Senecio Alkaloids

Manske[1] and Barger and Blackie[2] isolated from *Senecio retrorsus* of South African origin the alkaloid retrorsine, $C_{18}H_{25}O_6N$. Chemical investigations by me have since led to the isolation from the same species also of isatidine, $C_{18}H_{25}O_7N$, and a new alkaloid, possibly $C_{18}H_{25}O_8N$. The latter two alkaloids are water-soluble but insoluble in chloroform, and have a peroxide nature.

Catalytic hydrogenation of isatidine leads to the consumption of four molecules of hydrogen per molecule of alkaloid. Three molecules of hydrogen saturate three ethylenic linkages (two in the basic fission product and one in the acidic fission product). A fourth molecule of hydrogen combines with one peroxygen atom, which is present in the acidic portion of the molecule and which is then removed as one molecule of water. The hexahydro-desoxyisatidine ($C_{18}H_{31}O_6N$) so formed is crystalline.

The dibasic isatinecic acid, $C_{10}H_{16}O_6$, and the base isatinecine, $C_8H_{13}O_3N$, are obtained by hydrolysing isatidine with barium hydrate. Isatinecic acid has



one ordinary carboxylic group and one percarboxylic group $\left(R\begin{smallmatrix}\diagup COOH\\ \diagdown CO.O.OH\end{smallmatrix}\right)$ which readily lactonizes to form a monolactonic monobasic acid, $C_{10}H_{14}O_5$, which is no longer a peracid, but contains the peroxygen atom in the lactone ring.

From *S. rosmarinifolius* Linn. a new alkaloid rosmarinine, $C_{18}H_{27}O_6$, has been isolated which yields on hydrolysis a new base rosmarinecine, $C_8H_{15}I_3N$, and senecic acid, $C_{10}H_{14}O_4$. Rosmarinine has one double bond only, that is, the one present in senecic acid and which can be hydrogenated catalytically to the saturated dihydrosenecic acid.

S. pterophorus D.C. contains besides retrorsine a new alkaloid pterophine, $C_{18}H_{23}O_5N$, which can be hydrolysed to retronecine, $C_8H_{13}O_2N$, and pterophnecic lactone, $C_{10}H_{16}O_6$.

The Senecio species responsible for 'bread-poisoning' in human beings in the Cape south-western districts, namely, *S. ilicifolius* Thunb., contains three toxic alkaloids, senecionine, pterophine and retrorsine.

These alkaloids are all physiologically active and contain the pyrrole nucleus typical of other Senecio alkaloids. Details of these results will be published in the ***Onderstepoort Journal*** in due course.

H. L. DE WAAL.

Veterinary Research Institute,
Onderstepoort,
South Africa.
Oct. 22.

---

[1] Manske, R. H. F., *Canad. J. Res.*, **5**, 651–659 (1931).

[2] Barger, G., and Blackie, J. J., *J. Chem. Soc.*, Pt. 1, 11–15 (1936).

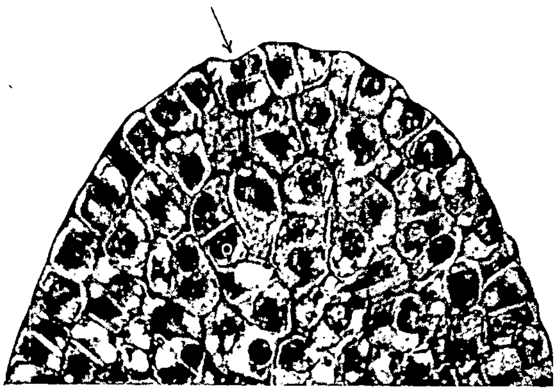
[3] de Waal, H. L., *Onderst. J. Vet. Sci. An. Ind.*, **12**, 155–163 (1939).

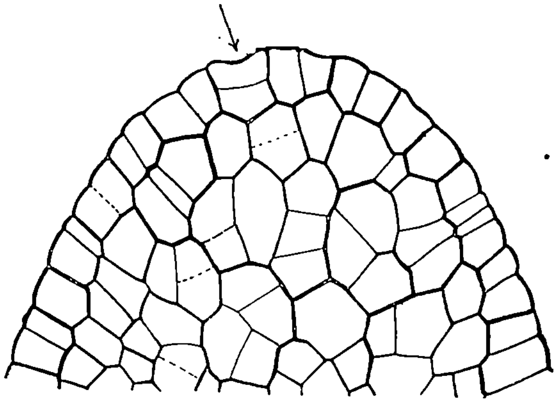
A Periclinal Division in the 'Dermatogen' at the Tip of the Maize Growing Point

THE accompanying photomicrograph and the cell-wall drawing show the periclinal division of a single isolated cell in the 'dermatogen' of a maize growing point (L.S.). In the more primitive vascular plants it has long been recognized that the outer layer of cells contributes to the central tissues of the apex by periclinal divisions. Recent workers have confirmed this for Lycopodium[1], and a number of Gymnosperms[2,3,4,5]. The above case shows that even in the Angiosperms, and even at the extreme apex in these, periclinal divisions sometimes occur in the outermost cell layer.

In the case of the cell concerned, its general shape, its position high up on the apex, the well-vacuolated cytoplasm of the daughter cells and the lack of rapid anticlinal divisions in the cells on either side, clearly indicate that the division is an isolated one and is not in any way foreshadowing the initiation of a leaf primordium. Examination of the series (cut at 5 μ) showed traces of the single division, at the same point in the cell, in at least three sections.

It is now generally agreed that there does not exist a dermatogen in the strict sense of the term as originated by Hanstein, since the outer layer often undergoes periclinal division during leaf formation. In the Dicotyledons it may be involved in the production of the leaf edge, while in the Monocotyledons it is frequently concerned in the initiation of the leaves and often contributes considerably to their inner tissues (Alstroemeria[6], Orchis[7], Dactylis[8], Triticum[9], Avena[10], and Tradescantia[11]). In more than twenty species of grasses (that is, in every one I have so far studied) periclinal 'dermatogen' divisions play their part in leaf primordia initiation. So far, however, there does not seem to be any case recorded of the 'dermatogen' contributing to the inner tissues of the apex. The case illustrated shows that it does sometimes occur in Angiosperms: perhaps future observations will throw more light on this point.





B. C. SHARMAN.

Botany Department,
The University,
Leeds, 2.
Nov. 14.

---

[1] Härtel, K., *Beit. Biol. Pflanzen*, **25**, 125 (1938).

[2] Cross, G. L., *Bull. Torrey Bot. Club*, **66**, 431 (1939).

[3] Foster, A. S., *Bull. Torrey Bot. Club*, **65**, 531 (1938).

[4] Foster, A. S., *Amer. J. Bot.*, **26**, 372 (1939).

[5] Korody, E., *Beit. Biol. Pflanzen*, **25**, 23 (1937).

[6] Priestley, J. H., Scott, L. I., and Gillett, E. C., *Ann. Bot.*, **49**, 161 (1935).

[7] Sharman, B. C., *J. Linn. Soc. Bot.*, **52**, 145 (1939).

[8] Bugnon, P., *Mem. Soc. linn. de Normandie*, **26**, 21 (1924).

[9] Rösler, P., *Planta*, **5**, 28 (1928).

[10] Kliem, F., *Beit. Biol. Pflanzen*, **24**, 281 (1937).

[11] Rüdiger, W., *Beit. Biol. Pflanzen*, **26**, 401 (1939).

RESEARCH ITEMS

Carbonic Anhydrase

THE physiological significance of zinc in the organism has been demonstrated for the first time by Keilin and Mann (*Biochem. J.*, **34**, 1163 ; 1940) who show that carbonic anhydrase is a zinc protein compound. This enzyme, which catalyses both phases of the reversible reaction $H_2CO_3 \rightleftarrows CO_2 + H_2O$, was discovered in 1933 by Meldrum and Roughton and was obtained as a colourless substance free from hæmatin and other known enzymes, stable within *p*H 3–12, thermolabile and very sensitive to KCN, H_2S, NaN_3 and to several heavy metals. The enzyme has now been prepared in pure or almost pure condition, having a catalytic activity 150 times that of the red blood corpuscle. As prepared from erythrocytes of ox and sheep by different methods, the enzyme has a constant zinc content of 0·33 per cent and contains no other metal. Also the enzyme activities of different fractions from erythrocytes and gastric mucosa run parallel to their zinc content. In the Tiselius cataphoresis apparatus the enzyme behaves like a homogeneous protein. Ultracentrifugal studies show that the enzyme has a size approximately half that of the hæmoglobin molecule, and hence each molecule contains two atoms of zinc. 100 ml. of erythrocytes contain about 0·21 gm. carbonic anhydrase, 0·06 gm. hæmocuprein and 28 gm. hæmoglobin. It is pointed out that carbonic anhydrase is the only known zinc compound which has characteristic catalytic properties, in contrast to zinc porphyrin, zinc insulin and zinc protein compounds of serum and tissues. Iron and copper are able to form compounds with different proteins, either acting as carriers of molecular oxygen or capable of catalysing a series of completely different reactions. The fact that the distribution of zinc in Nature is so much wider than that of carbonic anhydrase only shows that zinc, like iron and copper, forms with protein, compounds having different properties and functions.

Translocation of Minerals in Cotton

THERE seems to be quite general agreement as to the tissues responsible for the movement of sugars and water in the higher plant, but the position with regard to mineral nutrients still remains somewhat obscure. Another attempt to solve this latter problem has recently been made by Phillis and Mason, using as indicators of translocation, calcium (immobile in phloem) and phosphorus (mobile in phloem) (*Ann. Bot.*, N.S. 4, 635 ; 1940), and bromine (*loc. cit.*, p. 651). Sea Island cotton plants were used, and in the first investigation was confined to roots, stem, and two branches by judicious removal of developing buds. In this work, one set of plants were ringed at the base of one branch. There was an initial collection of normal plants and three subsequent collections of ringed and normal plants over a period of fourteen days. Ringing caused a slight reduction of both calcium and potassium uptake in the plant as a whole, but the ringed branch itself was found to contain more potassium and less calcium than either the unringed branch or the branches of the normal group. The results are in harmony with the view that the bulk of the solutes move upwards in the wood and, provided they are mobile in the phloem, are re-exported down the stem in this tissue. Phosphorus is trapped by the ring and therefore accumulates. The effect of transpiration on mineral uptake is the subject of the second paper. The authors point out that previous attempts to separate the effects of transpiration and assimilation (leading to transport of sugars to the roots and a possible change in uptake) have been largely unsuccessful; they therefore observed plants in which the roots are isolated by a phloem ring at the cotyledonary node. After two hours exposure to light both normal and ringed plants had absorbed bromine rapidly. While the presence of the ring had depressed slightly the uptake of bromine by the roots (below the ring) no appreciable difference was observed between the tops of the two series. Subsequent determinations on ringed plants in light and in darkness established the fact that transpiration increases uptake of bromine. It is suggested that transpiration affects uptake by altering the concentration in the absorbing region of the root (and possibly also by oxygenating the root), while assimilation is active by altering the solvent capacity of the root. Mineral nutrients thus appear to travel up the stem in the wood ; whether, in normal plants, a proportion also ascends in the phloem is not yet clear.

Diseases of Pasture Grasses

THE age-long practice of grassland farming is now enlarged to include the finer aspects of its technique. 'Winter burn' is a significant condition of poor yield which scarcely troubled our grandfathers, but is now recognized as worthy of investigation. Kathleen Sampson and J. H. Western, in a study of possible mycological contributions to this state, have described two grass diseases new to Britain (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 255–263 ; 1940). These are caused by the fungi *Helminthosporium siccans* and *H. vagans*. The former produces oval chocolate-brown spots upon the leaves of rye grass and meadow fescue ; the latter induces dark purplish-red lesions upon the foliage of smooth-stalked meadow grass. *H. vagans* appears to attack from infested soil, whilst *H. siccans* seems to depend more upon aerial methods of spore dispersal. Neither disease is severe of itself, but their possible contribution to a general condition of low yield warrants their study by mycologists in this disease-conscious age.

Rust Fungi Attacking the Thistle

SEVERAL species of thistle are subject to attack by various rust fungi, the taxonomy of which has been somewhat confused. Dr. Malcolm Wilson has investigated this subject (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 244–250 ; 1940) and has found that the greatest discrepancy lies in the identification of *Puccinia Syngenesiarum* on *Cnicus palustris*, which is usually *P. Cirsii-palustris* (*P. Le Monnieriana*) on that host. *P. Cardui* and *P. Circii-oleracei* are often wrongly recorded upon *Cnicus lanceolatus* as host, for they appear to confine their parasitism to other species of the host genus.

Foliage Blight of the Bulbous Iris

THE growth of bulbous Irises upon a commercial scale in the south-west of England has accentuated several maladies such as ink disease and leaf spot. Still another parasite has been discovered in a Phytophthora blight of the foliage, recently described by Gordon W. Gibson and P. H. Gregory (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 251–254; 1940). This fungus, which is possibly related to *P. Cyperi-rotundati*, causes the appearance of ill-defined whitish lesions upon the leaves. Spore characters are described, but the fungus has hitherto defied artificial culture. Suggested control measures are based upon methods of plant sanitation.

Standard Disks in the Strain Testing of Glass

A PAPER on this subject was read by E. J. Gooding at a meeting on November 20 of the Society of Glass Technology. Glass disks with standardized degrees of strain (described shortly as standard strain-disks) have been used at eleven bottle factories and one other glass factory. The results and comments of the observers were correlated by the author. Four different types of strain-viewer have been used, and a large variety of glassware has been examined in respect to its weight, thickness and contents capacity. The method is most easily employed in conjunction with a strain-viewer which has a large, uniformly illuminated field of view, with uniform polarization over a relatively large area. In general it is agreed that the strain disk method of comparison is simple and trustworthy, is useful for training personnel, and that good agreement between different observers is obtained. When the degree of strain is small, observers rarely disagreed by more than one disk, colourless or pale green bottles being used; but when it is greater than normal, agreement between observers is not so good. The disks are not particularly suitable for use with amber or dark green bottles unless a suitable colour tint plate can be superimposed on them. It is agreed that for bottle examination no revision of the degree of strain of the disks is necessary. Only about 1·5 per cent of the ware examined has a strain grading greater than three disks.

Sydney Observatory Astrographic Catalogue

THE section of the sky assigned for purposes of the Astrographic Catalogue to the Sydney Observatory lies between − 51° and − 65° declination. Of the fifty-two Catalogue volumes which publication of this work will necessitate, seventeen have now been issued. The latest (22. Sydney, 1940) covers − 56° to − 58°, 6–12 hr. in right ascension. It gives, in the usual way, rectangular co-ordinates and diameters of the star images. The latter, however, are not linear measures, but indicate the grade of the image according to a calibrated scale of comparison images used in the micrometer. Plate constants have not yet been computed, but space is left for their insertion when available, in the appropriate positions in the catalogue.

Variation of Faint Fraunhofer Lines

M. G. ADAM showed in 1938 (*Mon. Not. Roy. Astro. Soc.*, **98**, 112; 1938) that there was an anomalous behaviour of faint Fraunhofer lines towards the limb of the sun, for the region λ 5100. From absolute measurements at centre and limb it was shown that the equivalent widths of strong lines decreased to the limb, in accordance with theoretical considerations, but that faint lines showed a marked strengthening for which no explanation could be given by the usual theories of line formation. The latter phenomenon was finally ascribed to reduced re-emission in faint-line frequencies, which was interpreted as interlocking. The possibility of interlocking does not exist for all faint lines, and the correctness of the interlocking hypothesis has now been tested by the method described by Adam (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The term 'rare-element faint lines' is applied to the Fraunhofer line which may be faint because it originates from an oscillator of low relative abundance, and the term 'abundant element faint lines' is used if the line originates from a transition of low probability in an abundant oscillator. Equivalent widths at centre and limb of the sun were obtained for twenty-three rare-element faint lines and seventeen abundant-element faint lines in the region λ 4100, and for both classes a marked increase in equivalent width at the limb was established. The abundant-element faint lines showed a slightly greater increase than the rare-element faint lines. An examination is made of the existing theories of absorption-line formation, the two types of atmospheric models being considered, the Schuster pure scattering atmosphere model and Eddington's model, in which the continuous spectrum is formed all the way up in the atmosphere. The conclusion is that the strengthening of faint lines is due to an anomalous temperature distribution in the outer layers of the solar atmosphere.

Distribution of Sunspots Over the Sun's Disk

G. H. A. ARCHENHOLD has discussed the distribution of sunspots as a function of longitude from the central meridian (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The material utilized was taken from the Greenwich Photoheliographic Results, and the daily results up to the year 1915 give the details of the position and area of single spots and also of the more important individual spots composing the groups. There is evidence that the area of a sunspot, which has already been corrected for geometrical foreshortening, is also affected by physical foreshortening, which increases from centre to limb and also slightly from small to large spots. At long. 65° the physical foreshortening amounts to about 10 units of area, and at long. 80° it amounts to about 50 units (a unit is the millionth of the sun's visible hemisphere). The physical foreshortening, implying that a sunspot appears smaller if looked at from a greater angle of observation even when its area is corrected for the geometrical foreshortening, suggests a structural feature of sunspots. If a sunspot has the shape of a flat dish or funnel, it should show an increase in corrected area as it approaches the limb, because, with increasing inclination to the line of sight, the depth to which an observer can look into the sun decreases. From the observational facts given in the paper it is evident, however, that the cross-section of a sunspot decreases in the higher levels of the sun's surface, and this view is confirmed by certain theories of spots advocated by Minnaert and Wanders about eight years ago. Among other matters discussed is the Maunder effect, which amounts to an eastern excess of 7·5 ± 1·4 per cent (mean error) for groups in the period 1888–1915, the physical cause of which can be found in the slope of the axes and the preponderance of faculæ on the eastern side of sunspots.

BRITISH RHEOLOGISTS' CLUB

INAUGURAL MEETING

At the inaugural meeting of the British Rheologists' Club held at the University of Reading on November 16, a discussion on "Rheology in Industry" was introduced by Mr. J. Pryce Jones. In the unavoidable absence of the president, Prof. G. I. Taylor, the chair was taken by Prof. J. A. Crowther.

Rheology is defined as the 'science of the deformation and flow of matter', and Mr. Pryce Jones stressed the diversity of materials and of the properties of materials which the rheologist has to study. He went on to propose that the Club, or a committee appointed within it, should attempt to make a classification of the essential rheological properties of a number of industrial materials so as to construct a rheological table such as was recently proposed and attempted on a limited scale by Scott Blair (*J. Sci. Inst.*, **17**, 169; 1940). But first it is essential to define the terminology to be used. Such a term as 'thixotropy' is used by different workers in very different senses, and even when the original definition of Freundlich is referred to, definitions of the terms 'sol' and 'gel' are by no means standardized.

Mr. Pryce Jones went on to discuss the property of *Spinnbarkeit*, and gave some interesting demonstrations of both this and thixotropy, but the main part of his paper was concerned with a description of an extremely ingenious new viscometer especially designed for the study of anomalous liquids. This instrument, shortly to be described in the literature, consists of two Couette units rigidly attached to one another and rotated at the same speed in opposite directions. One of these contains an oil or other true fluid of known viscosity, and in the other is placed the materials to be investigated. The speed at which the couettes rotate can be varied, but if both contain true fluids, the frame connecting the two does not rotate so long as the speed of both is the same. If one of the couettes contains a material the viscosity of which varies with rate of shear, a deflection is observed and can be measured.

Mr. Pryce Jones concluded by discussing the connexion between anomalous viscosity and elastic recoil.

Mr. F. D. Farrow urged the importance of a careful scrutiny of the way in which rheological data are published. Since the methods of analysing such data are still in many cases tentative, it is important that the experimental figures should be given in their original form. The definitions of the term 'sol' and 'gel', 'solid' and 'liquid' were much discussed, Mr. Pryce Jones proposing that any system showing elastic recoil should be classed as a gel, and asking whether anomalous viscosity need be in all cases associated with elastic recoil. Dr. P. Halton and Dr. P. White also spoke on this point, the latter suggesting that, if we regard truly elastic behaviour as analogous to bright sunlight, and truly viscous behaviour to complete darkness, most industrial materials would fall in the twilight zone, and that consequently the distinction between 'sol' and 'gel', though convenient in practice, may be illusory in theory.

Dr. G. W. Scott Blair congratulated Mr. Pryce Jones on his most interesting new viscometer (as did several other speakers) but questioned the advisability of his definition of 'gel', which would include many quite dilute sols such as ammonium oleate (see Hatschek and Jane, *Koll. Z.*, 40, 53; 1926).

It was generally agreed that the closer co-operation which the new Club can make possible between rheologists working in different industries will be extremely valuable. That this was appreciated was shown by the fact that the Club already has a membership of sixty-five, and that in spite of the difficulties of the present time, about twenty-five were present at the meeting.

ELECTRICAL DEVELOPMENT IN THAILAND (SIAM)

A series of useful articles are being published in the *Electrician* which will prove helpful to electrical manufacturers looking for export markets. In the issue dated November 15, the export market to Thailand (formerly Siam) is discussed.

During the past few years Thailand has developed a sound constructive policy, including the promotion of land, water and air transport and communications. This widespread plan, which as well as including road making, also provides for the improvement of harbour facilities at Bangkok.

Under its scheme of development, the Government spent 370,000 ticals (11 ticals = £1) on its wireless broadcasting station during the period April 1, 1938—March 31, 1939 (year of the Buddhist Era 2481), 2·2 million ticals on the Post Office, 4 million ticals on transport and development at the port of Bangkok, and 103,000 ticals on turbines for the Samsen power station. Over a period of four years there has been a steady increase in the demand for electrical goods, apparatus and machinery. This followed naturally from the development of municipal amenities. The figures for 1937–38 show electrical imports of 2,575 thousand kilograms, valued at more than 3 million ticals.

Analysing these figures, the United States led with imports valued at 823,000 ticals; Germany took second place with a value of 553,000 ticals; from the

United Kingdom the imports were valued at 405,000 ticals. Japanese competition was confined mainly to cheap electrical goods, including lamps, and was responsible for a total of 330,000 ticals.

Comparing these figures with those for 1936–37, during which period Thailand imported nearly 2½ million ticals worth of electrical goods and apparatus, it is possible from the figures given to gauge to some extent the growth of the market. Figures for the total of all imports show that in 1936–37, the United Kingdom supplied goods to the value of more than 11 million ticals; Germany nearly 6 million ticals, and Japan more than 28 million ticals. For 1937–38 they show that the total of goods supplied were more than 13 million for the United Kingdom, nearly 7 million from Germany, and 22 million from Japan. This reflects a slackening of the Japanese competition.

Bangkok, the principal city, is developing rapidly. Up-to-date electric tramways are in operation. The first public wireless service between Thailand and foreign countries was inaugurated in 1929, and to-day Bangkok is in direct communication with eleven foreign stations—Berlin, London, Paris, Tokyo, Hong Kong, Manila, Saigong, Bandoeng (Netherlands East Indies), Calcutta, Penang and Rangoon.

There is in operation a wireless telephone service between Thailand and Europe, as well as a radio picture telegraphic service and radio service for air and marine navigation. For internal wireless communications, stations have been established at various centres. In 1937 a medium wave transmitter of 10 kw., working on a wave-length of 400 metres, was added. Work has now been begun on the erection of a more powerful transmitter near Bangkok. It will be rated at 100 kw. Six studios and three announcers' booths are to be installed in a new General Post Office building included in the scheme.

The language problem should not prove a bar to trade, for English is widely used commercially, and it is only in bazaar work that a knowledge of the national tongue is necessary. While, by comparison with other overseas markets, Thailand is as yet only small when considered from the electrical exporter's point of view, it is a market which will undoubtedly expand in the next few years.

FREEZING AND COLD STORAGE OF FISH

A REPORT from the California State Fisheries Laboratory* claims that the problem of preserving tuna on fishing voyages of several weeks duration, in good condition for canning, has been solved—at least on a small scale—by the application of freezing and cold storage. This announcement may serve as a reminder that the problem of so improving the preservation of fish at sea as to reap the full benefit of the ever wider extension of fishing made possible by the construction of larger, more speedy and generally more efficient catching vessels, is also a pressing one in Europe, and that its solution by freezing and cold storage has been repeatedly advocated of recent years by the Food Investigation Board on the basis of work done at the Torry Research Station, Aberdeen.

While most modern British fishing vessels successfully undertake voyages lasting three weeks or even longer, some reaching to well within the Arctic Circle, the universally employed means of preserving the fish, namely, storage in crushed ice, have in such circumstances proved inadequate, with the result that a considerable proportion of the total catch is landed in poor condition. Ice, in fact, will normally preserve white fish in really fresh condition for little more than one week. Freezing, on the other hand, promised not only to avoid staleness in long-distance fishing but also, if cold storage were continued on shore, to steady available supplies of the various food fishes independently of seasons and circumstances. Research has clearly shown that fish of all sorts can be kept in a condition practically as good as freshly caught for several months—even for much longer in the case of most white fish—if certain technical principles are observed. The fish must be frozen while strictly fresh and stored at temperatures in the range −20° to −30° C. In addition, freezing to these temperatures should preferably be completed within two or three hours. Only by employing such low temperatures is it possible sufficiently to retard various types of deteriorative change affecting odour, flavour and texture†.

The poor quality of the relatively small amount of fish frozen annually in the past must be held responsible for such prejudice against frozen fish as now exists. There appears to be little doubt that these fish were frequently frozen when already stale, and they were certainly stored at much too high temperatures, for example, −6° to −10° C., besides being as a rule very slowly frozen.

Unless a shore station can be established very near abundant fishing grounds, as, for example, in eastern Canada or Iceland, or in Great Britain with respect to the herring fishery, it is necessary to freeze the fish on board ship. A large factory ship with an attendant flotilla of small catching vessels could range remote seas for months at a time; alternatively, a super-trawler fitted to freeze and store as well as catch fish could operate nearer home for periods of some weeks. The former scheme has already been tested by British enterprise and the latter by French; and with return to peace conditions it is to be hoped that these pioneer attempts will be followed up, and that eventually Great Britain may be assured at all times of a steady supply of all kinds of fish of uniformly high quality. It is of present interest to note that part of the shortage in the home supply occasioned by the War is being met by the import of frozen fish; but it is well also to remember that at such a time considerable difficulties may frequently stand in the way of treating the fish in the best possible manner.

GEO. A. REAY.

---

* The Refrigeration of Tuna. Progress Report No. 2. (California State Fisheries Laboratory, Terminal Island, California.)

† See Reay, G. A., "The Freezing and Cold Storage of Fish", *Modern Refrigeration*, July 18, 1940.

RESPIRATION IN THE HIGHER PLANT

Aerobic breakdown of sugars can conveniently be studied in two stages—glycolysis followed by oxidative processes. Both phases have been discussed recently (*New Phyt.*, **39**; 1940). James and James (*loc. cit.*, p. 266), continuing the work on pyruvic acid metabolism, have shown that inactivation of carboxylases in barley, either by acetaldehyde or by one of a number of aromatic sulphonic acids, leads to accumulation of pyruvic acid in amounts which enable the isolation of identifiable hydrazones. The position of pyruvic acid in the aerobic respiration of barley is now considered sufficiently clear by James and his collaborators to allow the statement of a chain of reactions involving ascorbic acid oxidase:

$$\text{hexose} \xrightarrow[1]{} \text{hexosediphosphate} \xrightarrow[2]{} \text{triosephosphate} \xrightarrow[3]{}$$

$$\text{phosphoglycerate}$$

$$\downarrow$$

$$\text{pyruvic acid.}$$

Reaction 3 involves the oxidase. Pyruvic acid is metabolized to acetaldehyde and carbon dioxide in the usual way, though it is considered that the former may not be respired directly in young tissues, but may rather be concerned with synthesis (Report of Soc. for Exp. Biol., *loc. cit.*, p. 335). The oxidative stage in plant respiration involves one or more of a series of enzymes.

In a review of the various possibilities Boswell and Whiting (*New Phyt.*, **39**, 241; 1940) discuss the three principal oxidase systems and also other systems of less importance. They base their study on the observation of Szent Györgyi that only catechol compounds, ascorbic acid, and dihydroxymaleic acid give a pronounced violet coloration with ferrous salts in neutral solution. For example, in catechol, an iron-catechol complex is formed, and this, by electronic interchange between Fe^{++}, $C_6H_4O_2^{--}$ and Fe^{+++}, eventually releases free orthoquinone. Catechol oxidase is considered to act simply as a copper compound effecting oxidation by such complex formation, oxygen addition, and electron transfer. The importance of the three compounds listed above seems to lie in the fact that each carries a dihydroxy grouping. Oxidases may thus be regarded as protein plus firmly attached metal plus loosely attached prosthetic group or coenzyme containing a dihydroxy group. The chemical possibilities underlying oxidation by catechol oxidase, dihydroxymaleic oxidase, and ascorbic oxidase are discussed in some detail.

There is, however, no clear evidence that these last two are widely operative in plants. The more important catechol oxidase contains no peroxidase; it produces quinones, which act as hydrogen acceptors, and perhaps also hydrogen peroxide which is removed either by catalase or peroxidase. Among other iron complexes, the iron-porphyrins cytochrome and peroxidase receive most attention. The latter is stated to catalyse oxidations in the presence of hydrogen peroxide only. It may thus play a part in the catechol oxidase system by increasing the production of quinones. It is suggested that the respiratory chromogens of Palladin may be prosthetic groups loosely attached to unknown proteins.

NEW WORLD POPULATIONS

Raymond Pearl has examined statistics of the populations of the western hemisphere, the New World, in relation to corresponding figures for the Old World, so far as available, and taking certain bases of comparison as indexes of 'youthfulness' or the reverse in the populations compared (*Human Biology*, **12**, 3; 1940). Five of six attributes of populations generally regarded as of primary importance have been taken, the sixth quality being omitted on account of the difficulty of scientific appraisement.

(1) *Density of aggregation per unit of land area.* Central America, 37 persons per sq. mile; North America, 17 per sq. mile; South America, 12·8 per sq. mile, as against Europe, 189·5 per sq. mile; Asia, 108·6 per sq. mile (U.S.S.R. territory being omitted in both these). Broadly speaking, a relatively low density implies a comparatively youthful and vigorous stage of population.

(2) *Net percentage rate of growth per unit of time.* The comparative levels of population growth-rates may be taken as the clearest and least equivocal expressions of innate physical vigour, combining the forces of natality and mortality. The higher birth-rates are found among the biologically more vigorous, whereas in enfeebled populations the death-rates tend to be low. In such figures as are available from 1900 until 1935, the most impressive result is a well-nigh universal decline, but even so the population of the New World is growing at a much faster rate than that of Europe. The figures available are: Europe, 1900–10, 0·95 per cent; 1910–20, 0·22 per cent; 1920–35, 0·81 per cent. Western hemisphere, 1900–10, 2·24 per cent; 1910–20, 1·72 per cent; 1920–35, 1·68 per cent.

(3) *The natural rate of increase by excess of births over deaths.* This gives insight into the capacity for growth and general biological healthiness of a population at a given time. Figures for 116 countries are considered and again confirm the general biological healthiness of New World populations. The average vital index for the western hemisphere is 175·72 as against Europe 151, Asia (sampled) 152, Africa (sampled) 162, or a grand average for the eastern hemisphere of 152·38.

(4). *Age composition.* This attribute is of vital importance as reflecting the mass outlook on life and the psychology generally, as populations containing a relatively high proportion of young people are apt to display progressive and hopeful attitudes and to be aggressive in social and economic pioneering. Taking the life-cycle as falling into three divisions, the figures for the western hemisphere are: pre-reproductive, 39·0 per cent; reproductive, 50·6 per cent; post-reproductive, 10·4 per cent. For Europe, pre-reproductive, 27·9 per cent; reproductive, 52 per cent; post-reproductive, 20·1 per cent.

(5) *Racial composition.* As applied to the western hemisphere, just under 65 per cent of the combined total population is classified or regarded as white without other racial admixture.

RESISTANCE WELDING

WHAT may seem at first sight unlikely subjects can often be treated by resistance welding by carefully anticipating the conditions. Each welding possibility must be considered on its merits and not crippled by attempts to improvise a solution from a standard machine not suited to the special requirements of the case, and the advice of manufacturers should be sought.

The *Electrical Review* of November 15 shows what can be done in this way in a description of the Metrovick "A S P" heavy-duty spot welder; this machine is flexible enough to deal with light work also, and can be adapted for projection welding by changing the electrodes, which are bolted to top and bottom platens, for contact blocks. A 12-in. diameter double-acting cylinder provides a maximum pressure between platens of 9,000 lb. from air supplied at 80 lb. per sq. in. from reservoirs built into the top of the frame. Within the frame is a 250 kva. welding transformer having a secondary winding consisting of copper tube of square section brazed into cast copper headers through which the cooling water circulates. The primary has five tappings and a series-parallel connexion, all taken to a double-unit tapping switch on the frame giving a wide range of welding currents.

For straightforward projection welding, a contactor and timing device for controlling the duration of the weld have been found quite satisfactory. For more involved work, especially spot welding of heavy sections, the interrupted current method offers advantages. This method with 'woodpecker' control depends upon the employment of synchronous timing devices that allow instantaneous switching of heavy currents, as there is no inertia due to the moving parts, and permits the application of repeated and predetermined current impulses by a single operation. The use of interrupted current greatly lengthens the life of the electrodes when spot welding heavy sections, and so greater thickness of metal can be dealt with by any one machine. It is of advantage also on jobs that tend to 'flash' or blow out weld metal during the passage of the current. When spot welding thick pieces of steel together, the heat generated, combined with the high pressure applied to the electrode tips, tends to cause the material to anneal and the tips to 'mushroom' out and fuse to the steel. While the time between impulses allows the water flowing to the electrodes to control the temperature of their tips, the interval is insufficient for appreciable heat to be lost from the inside surfaces of the plates where the weld is being formed.

The control consists of an ignition panel for determining the welding current, and a small panel mounted on its side housing two thyratron-controlled relays for regulating the time at which set-up pressure is applied and the length of the forging period. The latter is the time of pressure 'dwell' after the weld is completed and before the electrodes are allowed to separate. A differential pressure is obtainable by electrically operated air valves, and the air can be exhausted underneath the piston at any desired stage of the cycle by means of the thyratron relay in order to apply a sudden pressure increase to the electrodes. This upset pressure is of considerable value in consolidating welds made in the thicker sheets and in obtaining a flush joint on projection welded assemblies.

FORTHCOMING EVENTS

Monday, December 16

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. E. A. Gunther: "Sierras of Venezuela".

Tuesday, December 17

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, London, S.W.1), at 1.30 p.m.—Mr. Alec George Vaughan-Lee: "The Mohammad Aly Barrages, Egypt."

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne), at 6 p.m.—Sir Stephen J. Pigott: "The Engining of Highly Powered Ships" (Sir Charles Parsons Memorial Lecture).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN THE DEPARTMENT OF PHYSICS AND APPLIED PHYSICS of the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (December 20).

LECTURER IN ELECTRICAL ENGINEERING at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (December 28).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1939, with Report of the Director of Fuel Research. Pp. iv+206. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [1311

Other Countries

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1930–1931. Part 1. Pp. ix+163. (Cairo: Government Press.) P.T.30. [511

Commonwealth of Australia: Council for Scientific and Industrial Research. Fisheries Circular No. 2: The Canning of Fish and Fish Products in Australia. By E. J. Ferguson Wood. Pp. 56. Pamphlet No. 100: Studies on the Marketing of Fresh Fish in Eastern Australia. Part 2: The Bacteriology of Spoilage of Marine Fish. By E. J. Ferguson Wood. Pp. 92. (Melbourne: Government Printer.) [511

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 133: A Soil Survey of the Mildura Irrigation Settlement, Victoria. By F. Penman, G. D. Hubble, J. K. Taylor and P. D. Hooper. Pp. 76. (Melbourne: Government Printer.) [611

U.S. Office of Education: Federal Security Agency. Leaflet No. 28: Education in the Union of Soviet Socialist Republics and in Imperial Russia—Selected References. Compiled by Severin K. Turosienski. Pp. ii+16. (Washington, D.C.: Government Printing Office.) 5 cents. [711

Proceedings of the United States National Museum. Vol. 89, No. 3093: Two New Anuran Amphibians from Mexico. By Edward H. Taylor. Pp. 43–48+3 plates. (Washington, D.C.: Government Printing Office.) [711

Proceedings of the United States National Museum. Vol. 88, No. 3090: Seven New Species and One New Genus of Hydroids, mostly from the Atlantic Coast. By C. McLean Fraser. Pp. 575–580+plates 32–33. (Washington, D.C.: Government Printing Office.) [1111

Field Museum of Natural History. Anthropological Series, Vol. 27, No. 2: Notes on Skidi Pawnee Society. By George A. Dorsey and James R. Murie. Pp. 65–120. 40 cents. Botanical Series, Vol. 22, No. 3: Studies of American Plants, XI. By Paul C. Standley. Pp. 131–218. 50 cents. (Chicago: Field Museum of Natural History.) [1211

Publications of the Observatory of the University of Michigan. Vol. 8, No. 3: A Self-Recording Direct-Intensity Microphotometer. By Robley C. Williams. Pp. 45–56. (Ann Arbor, Mich.: University of Michigan.) [1311

Rubber Research Institute of Malaya. Annual Report, 1939. Pp. 278. (Kuala Lumpur: Rubber Research Institute of Malaya.) 1 dollar. [1311

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology. No. 6: Items 4770–4868, April, May, June 1940. By Ernest A. Hodgson. Pp. 89–104. (Ottawa: King's Printer.) 25 cents. [1411

U.S. Department of Agriculture. Farmers' Bulletin No. 1850: The Armyworm and its Control. By W. R. Walton and C. M. Packard. Pp. ii+12. (Washington, D.C.: Government Printing Office.) 5 cents. [1511

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, DECEMBER 21, 1940 No. 3712

FOOD SUPPLIES AND THE BLOCKADE

THE fact that there was a serious food shortage in Germany towards the end of the War of 1914–18 makes people more ready to believe rumours that already in this War the shortage of food in Germany and in German-occupied countries is so serious that it may soon paralyse the Nazi war effort. These rumours should be received with caution. In the two or three years before the outbreak of the present War, there were numerous statements suggesting that food shortage, financial difficulties and other internal troubles were acute and that there were signs of a breakdown in the economic system which would bring about the collapse of the Nazi regime.

Whatever the origin of these rumours, their effect was to deceive the world about the real military strength of Germany. In view of the suggestion that, on humanitarian grounds, the blockade should be relaxed to allow food to reach the people in occupied countries, it is of interest to review what happened in the War of 1914–18 and consider whether events in the present War will follow the same course, as many people are too ready to assume.

The Germans fostered the belief that their defeat in the last War was caused by the starvation of the civilian population through the Allied food blockade. The idea that the defeat of the German Army was due to the blockade on food was assiduously cultivated in Germany as a means of getting the people to believe that the Army had not really been defeated. The food blockade certainly helped. But its main help was probably in reducing the output of munitions, owing to the deterioration of the health of the workpeople. The German Army was at full fighting efficiency in the summer of 1918. The Hindenburg line was broken and the Army defeated because the accession of men and armaments from the United States had, for the first time in the War, made the military forces of the Allies superior to those of the Germans.

Nor as a matter of fact was the blockade the sole, or even the main, cause of the acute shortage of food in Germany. In the five-year period before 1914, Germany produced 80 per cent of the food she consumed. The blockade was never complete. Germany continued to receive food from neutral countries in Europe. The deficit due to the blockade might have been made good by increased home-production, saving in wastage and efficient distribution. The consumption of food in Germany among the civilian population fell not by 20 per cent, which would have been the fall necessary had there been a complete blockade, but by about 50 per cent. The acute food shortage was due to the sacrifice of food for war ends. Nitrates, which should have been used for fertilizers, were used for making explosives. About two million farm workers were taken from the land for military service or for work in munition factories, and horses were taken from the farms for the Army. Because of the diversion of the national effort from food production to war ends, food production fell. Thus, for example, the yield of grain fell by about 22 per cent and the yield of sugar by nearly 35 per cent.

Further, part of the food that was produced, especially fats and sugar, was used for making explosives. Consumption of fat fell from the pre-war level of $12\frac{1}{2}$ oz. per head per week to about 2 oz., and of sugar from about $12\frac{1}{2}$ to $4\frac{1}{2}$ oz. The starvation of the German people was thus due more to the decision of the German Government to sacrifice food for war ends than to the blockade of the Allies. Then, as now, guns instead of butter was the policy. If the Allies had allowed food into Germany, the enemy would have been enabled to release a further part of the national effort from food production to war ends, or to use a greater proportion of the food available for making explosives. Lifting the blockade on food would have been almost equivalent to lifting the blockade on munitions.

It is very doubtful whether food shortage in Europe will play as important a part in this War as it did in the last. The building up of a food reserve was part of the Nazi 'military economy', established in 1934. Agriculture was organized to increase crops which give the maximum amount of food per acre and to adjust animal husbandry to give the maximum amount of human food for the feeding-stuffs consumed. The potato gives twice as much human food per acre as grain. Although Germany had a relatively large acreage of potatoes in 1939, an additional 15 per cent was asked for. This would provide roughly about six times as much potatoes per head of the population as the United Kingdom supplies. Reserves of grain and fat were built up. By April 1938, there was a reserve of 4 million tons of grain and by April 1939 the reserve increased to 7 million tons. Between 1933 and 1938, by developing home-production, the total supply of fat increased by 281,000 tons. But the increase was not consumed. In fact, the consumption of fat per head per annum fell from 58 lb. in 1932, before the Nazis came into power, to 55 lb. in 1937. The additional fat had either gone into reserve or, on Goering's plan for sacrificing butter for guns, been used for the manufacture of explosives.

At the end of the four-year plan, which adjusted agriculture to military ends, Germany may well have been nearly self-supporting in food with considerable reserves. Any depletion of reserves has probably been made up by food taken from the occupied countries. It is very doubtful, therefore, whether there is any food shortage in Germany, or at least any shortage likely to interfere with the war effort.

A consideration of the food position of Germany and of the countries now occupied makes it probable that the food supplies now controlled by the Nazis are sufficient to prevent any acute shortage if they are distributed according to needs. But the Nazis are likely to use their control of food to suit military needs rather than the nutritional needs of the people. Control of food can be used as a means of keeping conquered people in subjection. Although a sudden shortage of food among a previously well-fed people might cause revolt, a gradual deterioration in the diet is more likely to be accompanied by physical weakness, loss of courage and will-power and general apathy. People suffering from malnutrition and undernutrition are easily kept in subjection.

It would be foolish to hope for a collapse of the Nazis in the near future owing to food shortage. It would be safer to assume that their present reserves will be sufficient to carry them on to the next harvest. It would be equally foolish to depend upon food shortage as a means of defeating the enemy next year or the year after. It is difficult to set limits to the extent to which food can be increased by modern agricultural science, provided there are sufficient fertilizers and labour. By exploiting to the fullest extent all the lands of Europe which they control and all the subject labour, and by arranging distribution to suit military ends, the Nazis may well be able to maintain the strength of the war machine unimpaired indefinitely.

If, as we believe, the Nazis can, by devoting sufficient effort to it, produce sufficient food to maintain the efficiency of the war machine, what is the value of the food blockade ? A food blockade is a valuable part of our war effort because any food allowed into countries occupied by the Nazis enables them to withdraw an equivalent part of the effort devoted to food production to direct war ends, and to that extent increases their military efficiency. Further, although explosives are not made from food to the same extent as in the War of 1914–18, large amounts of foodstuffs are being used for making motor-spirits and for other purposes connected with the manufacture of war material. The lifting of the blockade on food would be equivalent to the return to Germany of prisoners captured or the lifting of the blockade on petrol or other war materials.

There is evidently food shortage in unoccupied France, and there may be some degree of shortage in some of the occupied countries ; but to what extent it exists it is difficult to assess. Travellers' tales are notoriously unreliable, and official news from the enemy is calculated to deceive rather than to inform. It is being suggested that food might be allowed through in sufficient amounts to prevent suffering among the people of the conquered countries. Even if food were allowed in, there is no guarantee that the people would benefit. If the Nazis are unwilling to share the food they control with these people or even allow them to keep the food they have, it is very doubtful whether they would allow them to benefit from any food allowed in. Measures could, of course, be taken to ensure that the people received the actual food sent in, but there is nothing to prevent the Nazis, who have complete control, from withdrawing an equivalent amount of food either for the troops of occupation or for transfer to Germany. It has been suggested that dried milk and cod liver oil might be allowed in to prevent malnutrition, but the Nazis could take away an equivalent amount of dairy products.

The only way to bring relief to Europe is to defeat the Nazis and drive them out of the conquered countries. Anything which will contribute to the destruction of the Nazi war machine will contribute to the relief of the conquered people. Any food, or other material which can be used for war purposes, allowed into the part of Europe controlled by the Nazis, strengthens the Nazi war machine and, to that extent, delays the deliverance of the people of Europe. But preparations should now be made so that food and other forms of assistance may be rushed to these countries as soon as they are liberated. Attention should be given now to what foods will be most effective in rectifying the evil effects of shortage during the enemy occupation, and the organization for the transport and distribution of the food got ready.

The action which ought to be taken now and after the War should be based on facts and not on opinions formed from rumours and enemy propaganda. Until war broke out, there was an international committee of nutritional experts, including prominent American and British men of science nominated by their respective Governments. For three years before the War, this committee, in collaboration with a committee of economic and agricultural experts, was engaged in studying the food position in Europe. It would be better able to assess the true position and make recommendations than any other body which could be set up. Further, it had experience of similar work in advising on food relief measures for Spain. The United States and the British Commonwealth of Nations might well appoint the American and British members of this committee, with an American chairman, to investigate the position and report on the present food position in Europe in so far as information is available, the means which ought to be taken to relieve distress arising from food shortage in Europe, and also on the economic and political measures which should be taken to base post-War world food policy on nutritional needs. In its pre-War studies, this committee found that the basing of food policy in the nutritional needs of the people would, in addition to bringing about a great reduction in disease and a rise in the standard of living, bring prosperity to agriculture and increase international trade. The committee suggested could make sound recommendations based on ascertained fact to deal with the present position, and could also make an important contribution to the building up of the new and better world order we are looking for after the War.

Every means should then be taken to let the people in Nazi-occupied Europe know that the free countries are making elaborate preparations to bring food and other forms of assistance as soon as the Nazis are defeated. The knowledge that these preparations were being made on the recommendation of a committee of scientific men, all of whose names are well-known in every country in Europe, would help them to endure the evils of their temporary bondage and encourage them, at the appropriate time, to assist in their own deliverance.

TRADITION IN A NEW WORLD ORDER

WE live in the birth-pangs of a new world. Of what order that world will be now hangs on the arbitrament of war. Should the final decision be, as we hope and confidently expect, in favour of Great Britain and her Allies, to them will fall the task of moulding the new world in that shape which the ideals and principles for which we have taken up the challenge of dictators and totalitarian States may best be given practical effect. The burden will be heavy; and not the least onerous part of the task will be how best to ensure that in the endeavour to attain a state of permanent peace in the future by bringing about co-operation between peoples and nations in all matters which pertain to the common interests of mankind, loyalty to these principles and ideals may be maintained without impairing either sense of freedom in action or individuality. At the close of the War of 1914–18 it is true that these elements of freedom and individuality were stressed over-strongly. The rights of minorities and the claims of the smaller national groups to self-determination were allowed to obscure the larger issue. This was largely a consequence, perhaps inevitable, of conditions which had preceded that great struggle. But when the time came for the League of Nations to take the strain, instead of a united team it proved to be rather an assemblage of disruptive forces in which sovereignty and national self-interest acted as the motive power and obscured the urgency of adherence to a common aim. The tradition of national and racial groupings, in the long run, rendered impotent attempts to secure full corporate action on the occasion of any major political crisis. A world which was to be "made safe for democracy", in the event, through the assertion of national claims in both the political and the economic spheres, became the opportunity of the dictator and of those whose specious arguments even in non-totalitarian States placed a delusive efficiency in public affairs above free discussion. In the result, democracy has been brought within measurable distance of the danger of extinction.

Many writers over a long period of years have prophesied the coming of Armageddon, when man would destroy himself and the civilization he has constructed by misuse of the powers of his own intellect and his control over the forces of Nature. Among recent writers Mr. H. G. Wells, in some of his early works, has drawn horrific pictures of a derelict world after the last great struggle has been fought to a finish. On the other hand, others, among whom Sir Arthur Keith has been conspicuous, have seen in war a moulding force by virtue of which racial, or rather national, types and characteristics are evolved. Without accepting the argument as valid in its entirety, it may at least be admitted that as a result in part of conditions arising out of the War of 1914–18 three new forms of political organization emerged—the League of Nations, the Russian Union of Soviets, and the British Commonwealth of Nations. Each of these was, in its respective method of approach to the problem of uniting a number of peoples in a single grouping, a step forward along the line of development of ever-increasing social and political units which is apparent in the evolution of human societies. Of the third of these, however, the British Commonwealth of Nations, it is perhaps not over-hazardous to say that it possessed the best chance of survival as being the least counter to tradition. It is in harmony with the trend of British institutions which have fostered local autonomy, not only in Great Britain itself in its municipal, district and county administrative bodies, but also in the legislative councils which hitherto had been responsible under the Imperial Government for the affairs of the Dependencies. At the same time the British Commonwealth stands alone in the history of political institutions in that it is a body composed of free and independent nations, in which any act of aggression of one member against another is well-nigh inconceivable.

The League of Nations was the latest of attempts since the *Pax Romana* and the Roman Empire to unite the peoples of Europe, or the greater number of them, in a single system. It differed from its forerunners in that it did not aim at complete political unity, but only at joint and corporate action in certain spheres of political, social and intellectual interest; it went outside the geographical boundaries of Europe and appealed for the co-operation of peoples of European civilization; and, most significant of all its differences from previous systems, it was based upon the voluntary principle and a degree of abrogation of sovereignty, and not upon force. It is, therefore, perhaps no matter for surprise that its most conspicuous success was precisely in those fields of activity in which before the first world war, interest, activities and joint action had been international and the barriers of national interests had been least operative—the field of the arts, sciences and social reform. In this respect it came near to reconstituting the international position of learning and the arts in Europe before the Reformation.

The fate of the League of Nations was a clear indication that the times were not yet ripe for so great a break away from the nationalist tradition. It has required the shock of a second world war and the imminent peril of free institutions throughout the world to bring once more into the field of practicable discussion the possibility of finding a basis of corporate action between nations which will ensure conditions of enduring peace. We may learn this lesson not only from America, where the President of the United States is urging upon peoples of very different civilizations in North, Central and South America, the necessity of a measure of common action in the interests of their common devotion to the ideal of political liberty, but also from the aims of our adversaries. They too, Germany in Europe, Japan in the East, are formulating a political system which transcends national distinctions, but under the dominance of a ruling caste—a reversion, it is to be noted, to the system of barbarism which in European history followed on the period of migrations rather than a step forward along the line of what has been noted as evolutionary social development. German dominance, however, in the occupied territories and in the countries subordinate to the Axis contrasts, to its disadvantage, with even the darker period of the Middle Ages in the complete repression of things of the spirit and the eradication of all freedom of thought by the suppression of universities, schools and centres of learning which are not prepared to follow the paths marked out by political expediency.

Over against this spreading cloud which seeks to blot out every path leading to the development of the spirit of man, there stands Great Britain, her Allies and every free people which holds fast to the ideas of democracy, even though they may not yet go all the way with the United States in giving Great Britain every aid short of war. The aim of those who fight for the cause of democracy is not merely to ensure a lasting peace, but also that it shall be a peace in conditions which are a guarantee of the continuance of free institutions, and for the individual the fullest opportunity for the development of his character and capacities. This cannot be stated too emphatically or too frequently. In this connexion attention may be directed to a volume of speeches by Lord Halifax* in which implications of the democratic ideas as a political principle are set forth with wholly admirable lucidity and force. These speeches dealing with foreign affairs and the principles of British foreign policy were, many of them, though not all, delivered in the course of debate in the House of Lords, and the editor has provided a summary of events leading up to each speech. Hence this volume may serve as a useful reminder of the course of events in the most fateful years of the history of Great Britain. Not only do they carry great weight in their more general passages dealing with political practice and theory, but also they have special authority in the later years when Lord Halifax speaks as the Secretary of State for Foreign Affairs and the spokesman of the Government in the House of Lords.

It is especially illuminating to recall the course of events and to note here how from faith in the League of Nations and collective security with a conciliatory attitude towards Germany, the Government passed through a phase of increasing distrust of the Nazi regime and misgiving as to the efficacy of the League, a period of regional pacts and so-called realism in international relationships and finally to complete disillusionment. Throughout, however, Lord Halifax stands fast by the ideal of democracy, from the time when in 1934, in addressing the educational section of Messrs. Rowntree's factory at York, he defined the object of government as "the fuller and freer development of human life" down to the latest speech here included, "The Challenge to Liberty," delivered at Oxford in February 1940, when he contrasted the spirit of German youth and British youth and defined British policy in the War as resting upon twin foundations of purpose—"determination to resist force" and "our recognition of the world's desire to get on with the constructive work of building peace"—the latter, as he had shown, a task which must be pursued in the Christian spirit of tolerance and justice.

While it is generally agreed that in a post-war settlement which aims at conditions of enduring peace it will be essential to bring about some form of co-operative or federal organization at the very least in Europe, it is obvious that to translate the democratic ideal into a working system presents many grave difficulties. Many practical problems have to be solved, some of which have already been discussed in the columns of NATURE. Of these, in a democracy, education on rising standards possibly comes first, but hygiene, unemployment and inter-State relations in exchange of commodities and in finance run education close. If we may learn from our adversaries, the *ostensible* uniformity of the system of finance and commercial relations proposed in the Nazi 'New Order' merits examination. So far as these problems approach solution so far will the task of the central organization approach fulfilment, but in both spheres, that of the practical problem and that of the affairs of the whole organization and of its relations with those outside its body, successful working will come not by the elimination of national and cultural differences, as many fear, but by their recognition and by the preservation of those forms of cultural tradition which by their very differences lead, as the history of civilization shows, to cultural advance.

---

* Speeches on Foreign Policy. By Viscount Halifax. Edited by H. H. E. Craster. Pp. x+368. (London, New York and Toronto: Oxford University Press, 1940.) 10*s*. 6*d*. net.

THE FUTURE OF COLONIAL POLICY

THE uncertainty of the reaction of the Vichy Government to German plans for obtaining control of French West Africa has already excited alarm, not only in Great Britain and in the United States, but also among the African peoples. It is not merely the strategic issues involved that arouse concern. With the shattering, at any rate for the time being, of Anglo-French co-operation in colonial administration and development, there has come a real threat to the new and liberal ideas of trusteeship embodied in the mandate system. These fears are unlikely to be allayed by the new co-operation between France and the Axis powers, whatever form that co-operation may take.

Nowhere indeed is the contrast between the Axis powers and Great Britain more marked than in the field of colonial policy. The rule of the Axis in Africa as elsewhere would mean the subjugation of the native populations to the needs and demands of Germany and Italy, the exploitation of their resources and people in the interests of the white races alone—the complete negation of the mandate principle and a reversion to the old, evil imperialism from which Africa has slowly emerged.

There have indeed been marked differences between French and British policy, but whatever these differences, the experiments and reforms either discussed or introduced down to the fall of France all reflect the view, common to both the French and British Colonial Empires, that the native is to be treated as an end in himself, a person to be associated in one form or another with the development and administration of his country. Whereas Anglo-French co-operation in this field has been interrupted, Britain's loyalty to the principle of trusteeship remains unshaken, and indeed is reaffirmed in the developments proceeding under the policy announced by the Colonial Secretary early in the year in the Statement of Policy on Colonial Development and Welfare.

This factor may not be without some influence on the situation in Africa and on the course of the war. The Vichy Government has already aroused too much alarm in the French Colonial Empire for it to risk further alienating native opinion and support. Indeed, the whole French tradition of colonial administration is one which should make the task of General de Gaulle and the Free French forces of winning the support of the native peoples at least throughout that Empire relatively easy. The importance of wise and far-reaching propaganda should not be under-estimated, above all if it is supported by administration of the territories under the rule of Free France and of Great Britain of a type calculated to hold and encourage the loyalty of the native peoples, whose desire for a British victory has indeed already received striking demonstration.

The tactical importance of the developments in colonial policy foreshadowed in the White Paper is far from being generally realized. The practical applications of the principle of trusteeship outlined there, if wisely implemented at the present time, may even have a decisive strategic effect on the war in Africa, if it enlists fully the loyalty and enthusiasm of the African peoples. Sir William H. McLean's admirable review of the proposals and their import in his Cantor Lectures on the "Social and Economic Development of the British Colonial Empire", recently published in the *Journal of the Royal Society of Arts* (87, 871–881; 891–914; 1940) is a timely contribution which should assist in the general understanding of what is involved.

Apart altogether from tactical or strategic questions, the colonial problem has several other aspects which give it special importance at the present time. It is in the first place one of the major issues which is bound to be raised at the peace settlement. In any attempt to deal with the real causes of the present War, the question of access to raw materials will require reconsideration, and this question can scarcely be separated from that of colonial policy, administration and development.

It is fair to say that the sub-committee of the League of Nations and the Royal Institute of International Affairs have already carried out the requisite inquiries as to the facts of distribution of raw materials, and a number of important suggestions or recommendations regarding access to such materials have already been ventilated. In this sense the matter might well be regarded as in an advanced state of preparation for consideration as part of a world settlement leading to a new order after the War. Whatever specific form that settlement may take, there can be no doubt that the implementing of such a policy as that outlined in the White Paper, and the firm establishment and enlightened administration of the Colonial territories during the War in the spirit of trusteeship, would go far to create an atmosphere of confidence and respect essential to a settlement reconciling the claims of all races involved.

The plan outlined by the late Sir Arnold Wilson in an appendix to "More Thoughts and Talks" (Longmans, Green and Co., 1939) for a system of pooled trusteeship, in which all the African colonies were gradually pooled in such a manner as to make them serve the common good both of the white races and of the natives, deserves close study and careful consideration. It offers advantages in gradual application, without transfer or decision of sovereignty for a generation, thus affording time essential to the education of public opinion for the idea of colonial trusteeship.

Schemes of this nature involve both careful investigation and equally thorough educational work. Both alike must be put in hand now if the colonial problem is to assist and not handicap the attempts and plans for post-War reconstruction. The value of the recommendation of the Hailey report for the establishment of an African Bureau has indeed been enhanced by all that has occurred since the findings of the African Survey were published in the autumn of 1938.

There is, however, a further and equally important respect in which the colonial questions are linked up with the problem of post-war reconstruction. The importance of the economic aspects of such construction have been repeatedly stressed, both in relation to a war strategy of organizing relief for Europe as soon as the Nazi tyranny is overthrown, and as part of a wider scheme of settlement and economic development which would aim at raising the general standard of nutrition and living in the whole continent, but especially in the more backward parts of eastern Europe. In both of these, colonial questions and resources may play a large part.

In the first place, there must be a review of outside sources, including the colonial territories, from which the deficiencies in the distressed countries can most easily be met. This will include the building up of surpluses not only in the Americas but also in tropical Africa. Besides those of cocoa, palm kernels, groundnuts and other human foodstuffs, animal foodstuffs and other raw materials must be included, some of which, such as cotton and jute, will also be required by post-war Europe. Moreover, as Dr. Julian Huxley has pointed out, not all surpluses can be stored as such; some require processing, notably the vegetable oils. Such processing may involve the purchase of suitable machinery from countries the industry of which is not overtaxed by armaments production and, like the provisions of storage facilities, should form part of a comprehensive plan. This again may powerfully affect the economic situation in tropical Africa, where indeed it may already be necessary to buy up the surpluses if the local producers are not to starve. Such purchasing must also be done at a fair price if inroads are not to be made on the educational and social services of the territories in question.

To buy merely to destroy would be a poor answer, both to the propaganda insinuating that we are responsible for shortage in the countries overrun by the Nazis, and to their plans for the economic reorganization of Europe. The plans already envisaged by the British Government for the building up all over the world of food reserves destined for the relief of Europe may well make as important a contribution to the economic welfare of the colonial territories as to the defeat of Germany, the countering of German propaganda, and to laying the basis for a stable post-war world. The provision of proper processing and storage facilities could be made the basis of greater stability in primary production, by providing large-scale reserves functioning as buffer pools.

Such considerations alone emphasize the importance of the economic developments envisaged in the Statement of Policy issued last February. It is only on a secure economic foundation that schemes of social advance can be planned and carried out continuously. The lack of secure markets in the past has been the main cause of suffering to the people in some Colonies; they were unable to sell their produce and had to lower their standard of living in spite of the efforts of the Colonial Government to safeguard that standard. The real problem of raw materials, as Mr. H. D. Henderson remarks in "Colonies and Raw Materials", is that of securing a square deal for the primary producer. The first emphasis in the enlarged policy of Colonial development is accordingly on the improvement of the economic position of the Colonies. The arrangements for increased assistance from the funds of Great Britain, while related to what the Colonies can do for themselves, are intended to facilitate full and balanced development, and to place Colonial

Governments in a position to maintain administrative, technical and social services at proper standards. They are intended to ensure the adequate financing of the research and survey work, the schemes of major capital enterprise, and the expansion of administrative and technical staffs which are essential for full and vigorous development, as well as the maintenance of an adequate standard of health and education services.

There is already much evidence that malnutrition is a factor in ill-health and inefficiency in many parts of the Colonial Empire. According to the report of the Committee of the Economic Advisory Council on "Nutrition in the Colonial Empire", malnutrition there is due first to a low standard of living; secondly, to the great ignorance and prejudice both as regards diet and the use of land; and thirdly, to the influence of diseases, particularly the widespread parasitic infections in the tropics, which react upon the state of nutrition of the individual. Improved nutrition depends largely upon economic development, and in the Colonial Empire this means primarily an improvement in agricultural development. Accordingly, in agricultural policy, the nutritional needs of the community are of first importance, and the report urges that the aim should be the establishment of a balanced agriculture for the production of commodities to be used either for direct consumption by the producer and his family, or for sale for consumption elsewhere in the territory, or for sale in overseas markets. Colonial Governments should encourage the people to grow at least a part of the foodstuffs they consume and endeavour to improve colonial dietaries by increasing the quantity of foodstuffs consumed and by increasing the variety.

It is not in eastern Europe alone that developments, designed to raise the standards of nutrition and living generally by relieving economy of some of its excessive dependence on primary products, may assist in raising standards of living and increasing social and economic stability elsewhere. Policies of social development undertaken to raise the standard of health and nutrition in the African Colonies, with their repercussion on the standard of living in those countries, should provide the same expanding market to the industrialized nations that the developments suggested by Mr. McDougall would provide in eastern Europe. The developments advocated by Lord Hailey in regard to research and adopted by the Government in the establishment of a Colonial Research Advisory Committee and in the allocation of a separate sum for Colonial research, have a direct bearing on the new order to be established in Europe, no less than in Africa.

It is indeed reassuring that such developments should be encouraged by Government action during the present struggle. Further co-operation in the study of agriculture and husbandry, of soil erosion, or of transport needs, the pooling of information about the methods used in checking the diseases to which the African is prone and for dealing with the widespread malnutrition that exists, may prove indirectly almost as valuable a contribution to the solution of some European post-war problems as directly to those of Africa itself. The prosecution of research into African problems on an adequate scale and the keeping up to date of the admirable African Survey may offer a most important contribution to reconstruction, possibly even to peace itself.

The developments at present contemplated are intended to facilitate the long-term planning which is a *sine qua non* of effective research in many such fields. Moreover, the emphasis thus placed on the economic development of the colonial peoples, the protection and raising of their standard of living, and their social development and training for self-government, should ensure that the position of the Colonies is viewed in all its issues at an international settlement. It affords unmistakable evidence that the principle of trusteeship is sincerely accepted and loyally fulfilled. It attests our capacity to shape within our own commonwealth at least our own form of co-operative society—in Mr. Herbert Morrison's words: "A free partnership of freely active groups, in which there is no room for mutual attempts at exploitation or for sharply differing levels of social and economic opportunity." Recognition of our responsibilities for the physical and moral welfare of these peoples and a determined effort to honour our trust are in such sharp contrast to all that has been revealed of the German attitude to such questions, of which the exclusion of the native peoples on principle from higher schools and universities enunciated by Dr. Gunther Hecht in "The Colonial Question and Racial Thought", is only one illustration that it can scarcely fail to enlist the loyalty and support of the native peoples of the African territories in a way which should effectively counter the consequences there of the collapse of France.

ELECTRIC AND MAGNETIC UNITS

M.K.S. Units and Dimensions and a Proposed M.K.O.S. System

By Prof. G. E. M. Jauncey and A. S. Langsdorf. Pp. viii+62. (New York: The Macmillan Company, 1940.) 4*s*. net.

A VERY large number of conferences has been held in recent years on questions connected with electric and magnetic units. Most scientific workers are content to use the units without discussing them, and have probably been relieved to find that in spite of many weighty pronouncements there has been no very noticeable change in current usage. There is, however, a vague idea abroad that important changes took effect in January 1940, and one of the objects of this book is to introduce to students the new position, the authors adopting the view that this is represented by the M.K.S. system.

The general situation, however, remains a little obscure. Some years ago the International Bureau of Weights and Measures announced its intention of abandoning the present International units, based on the silver voltameter and the standard column of mercury, and adopting units based on the absolute system. In practice, this would have meant that the familiar units, the ohm, ampere, volt, joule, watt, henry, and farad would have had their values adjusted to the extent of a few parts per 10,000. These changes, which were to have been made in January 1940, would have had legal backing, but, owing to the War, no action was taken and the International units still remain in force.

The decisions of the other conferences were on quite a different footing. The International Union of Pure and Applied Physics, and the International Electrotechnical Commission, made recommendations to physicists and electrical engineers respectively. The physicists were recommended to adopt the gauss, oersted, maxwell and gilbert as their magnetic units, and the C.G.S. system generally, while the engineers were recommended to use the weber as their magnetic unit, and the M.K.S. system generally. The physicists afterwards recognized the M.K.S. system as a tolerable modification of the C.G.S. system, and both physicists and engineers decided by majority votes that magnetic induction B, and magnetic force H, should be regarded as quantities of a different kind, and that therefore permeability (and permittivity or dielectric constant) should be regarded not as mere numbers but as quantities having dimensions.

The possible effects of these decisions on scientific workers is a matter of some importance. Will they in fact follow the recommendations of the conferences? A first glance at the literature of the last five years suggests that they will not; that they will continue to use the units to which they are accustomed. The September issue of the *Proceedings of the Physical Society*, for example, contains an account of a recent discussion in which the recommendations were attacked at least as frequently as they were supported. Mr. C. R. Cosens deplored "the redundant names of units", which "appear to be largely by-products of the labours of International Commissions", and Dr. Burniston Brown proves that μ and ε are pure numbers, as they certainly are if one accepts his definitions of B and H, which are at least workable. However, it does not follow that other concepts are unworkable. As Prof. Henri Abraham pointed out, as president of one of the conferences, "une question d'opinion métaphysique" is involved. Clearly such questions will not be decided by any fixed date. The final decision, if there is one, must depend on the experience of those who use and teach the concepts, and will probably rest largely with the university professors.

In this connexion this small volume by two American professors, one of physics and one of engineering, is of considerable interest. It is one of the very few signs which suggest that the M.K.S. system has made a little headway, and that physicists and engineers may ultimately agree to abandon the curious assortment of units which they now use in favour of a single system. For the most part, the book is a clear, straightforward exposition, suitable for students new to the subject, of the point of view implied by the decisions of the various conferences, although the authors express disapproval of the one decision which would have had legal backing, namely, the adjustment of the value of the ohm. They support the view, which has already been advocated in several quarters, that since even in an absolute system one electrical unit must be regarded as a primary unit on the same footing as the metre, kilogram and second, then for reasons of practical convenience in the preservation of the primary units, that unit should be the ohm, which should remain fixed in value, just as the kilogram and metre remain fixed, in spite of the failure to give them the values originally intended. The treatment of the M.K.S. system follows mainly the lines laid down in the pioneer work of Giorgi and G. A. Campbell, but whereas these writers would advise the student not to waste his time over superfluous systems like the two C.G.S. systems, the present authors outline all the systems. It may be doubted whether students will welcome the M.K.S. system merely as an addition to the others.

B and *H* are presented as quantities measured in different ways, and therefore of different dimensions. Some readers may doubt whether there is an inevitable connexion between the nature of a quantity and its dimensions, but the subject is skilfully expounded. The student is shown how the ideas work by a series of theoretical experiments, and even if the ideas may afterwards require overhauling, the book forms a good introduction to the subject.

L. HARTSHORN.

SEXUAL DISPLAY IN BIRDS

Courtship and Display among Birds
By C. R. Stonor. Pp. xv + 140 + 57 plates. (London: *Country Life* Ltd., 1940.) 8*s*. 6*d*. net.

AS is well known, the term 'sexual selection' was originally used by Darwin in two senses: first, with reference to the evolution of weapons like horns in ungulates and spurs in birds, such structures rendering their male possessors more efficient in combats for the mastery of the females with which they desired to mate; and secondly, in relation to decorative features possessed by the males and thereby making them more attractive to the female, which was supposed to exercise a preference towards mating with such males. The former process, as freely admitted by the earlier Darwinians, did not differ in principle from any other type of natural selection; but about the second there has always been much dispute.

Wallace, who based his conclusions largely on field observation, but partly on deductive reasoning, denied its existence in Nature, and other field naturalists have done the same. Mr. Pycraft in his book on the "Courtship of Animals" published in 1913, while saying that the theory of sexual selection was by no means exploded, was one of the first to give it a new interpretation. This he did in a way which now has the approval of many other zoologists, saying that the utility of the display and of the ornamentation which is correlated with it is to quicken desire in the individual to whom the display is directed, or, as he expresses it, that it has a sort of aphrodisiac action. According to this view, which was reinforced by the observations of Dr. Julian Huxley, sexual selection, wherever it occurs, must be a special case of natural selection, a conclusion which was arrived at on slightly different grounds by Sir John Graham Kerr. Of the many objections to the Darwinian theory of sexual selection the most cogent is one that oddly enough does not appear to have been urged until comparatively recently, namely, that sexual display is very usually performed by birds after they are already mated and cannot, therefore, have any connexion with any supposed preferential choice on the part of the female. There is, however, evidence that selection may take place with the ruff and the blackcock, as the late Edmund Selous has shown, as well as with some kinds of ducks.

In recent years there has been a convergence between the methods and results of field observation and those of physiological experimentation, and in no subject is this more marked than in the study of sexual behaviour. Researches into the comparative physiology of the generative processes as carried out in the laboratories have provided clues to the interpretation of animal behaviour as recorded by field naturalists, and there has been a stimulating reaction between the two kinds of study. This is well illustrated by such works as those of Mr. Eliot Howard and Dr. Fraser Darling, and the beneficial effects of such convergence are further shown in Mr. Charles Stonor's book on courtship and display. This is not saying that miscellaneous observations of natural occurrences in the field are not of value provided always that they are careful and accurate, and it is to be hoped that such studies, uncorrelated though they may be, may continue if only for the delight they afford to the watcher. Bateson some fifty years ago referred to such purely observational work as though it were a thing of the past: "In the old time," he said, "the facts of Nature were beautiful in themselves and needed not the rouge of speculation to quicken their charm, but that was long ago, before Modern Science was born." This is certainly not true of to-day, at least so far as bird watching is concerned. Nevertheless the æsthetic delight gained in this way is no whit depreciated by adding to it the intellectual pleasure of attempting to formulate a scientific hypothesis which co-ordinates and explains the facts.

In Mr. Stonor's very attractive book a definite physiological theory of sexual display and courtship is adopted and some of the evidence put forward and described. Such a theory had already been adumbrated by me in an article in NATURE of October 26, 1929, but the evidence in support of it as derived from comparative physiological studies as well as from the observation of animals is now much more considerable than it was then. It is thus picturesquely described by Mr. Stonor. After referring to the pituitary gland as a kind of general prompter or activator of the other ductless glands, and as "the leader of the endocrine orchestra", he proceeds as follows : "The important point for us is that this pituitary body is known to be affected in a direct way by messages sent to the brain via the eye. So that when a Paradise Bird performs his dances, or a Peacock shows the dazzling magnificence of his train, the unusual and arresting sight he presents to the female, like the incomplete clutch of eggs (of which birds also show a physiological awareness), makes a strong impression on her eye, is flashed back to the brain and to the pituitary gland, which sends out its message to the rest of the body via the substance it secretes, to tone itself up and get ready for the breeding season," the ovaries being stimulated.

In the second chapter Mr. Stonor describes and compares the displays of two quite unrelated groups of birds, namely, the birds of paradise and the gallinaceous or game birds, and the probable evolution of the different kinds of display. He shows that whereas in birds of paradise variations in form and in display have gone hand in hand, in gallinaceous birds variation in form has largely outstripped the development of display. He concludes by stressing one outstanding fact, that "no matter where the special adornments of a bird may be situated, no matter what form they take, they are always combined and synchronised with one another to produce the maximum possible effect."

The next two chapters are upon mutual and communal displays, and instances are described from among many different sorts of birds. It is shown that with mutual displays one sex is very usually more active than the other, but this is not always so, for with the great crested grebe and the wandering albatross the female is every bit as active as her mate. Moreover, there are certain birds, such as the button quail, the tinamous and the New Zealand paradise duck, where the female is the active partner in courtship, and in some of these species the incubation and care of the young are left to the male. It is pointed out that in the case of communal displays, apart from the 'advertisement value' of the gatherings, the presence of a large number of birds which perform in common helps to key up and stimulate each individual male and female which visits the group. This is in accordance with the observations of Dr. Fraser Darling, who found that collective display in communities favours and accelerates successful breeding as a consequence of mass effect in stimulation.

The next chapter is on display grounds which, as the author shows, provide a suitable and conspicuous setting for the display, and suggests that though these areas may have become mainly 'recreational', they were originally solely for the purpose of courtship. Communal display is shown by the ruffs and reeves, the black game, the herring and other gulls and many different kinds of birds in which the practice has been independently developed. There are also other kinds of display, such as the threat display, but, as pointed out, the same kind may be used at different times for more than one purpose by identical birds.

The final chapter deals with the author's general conclusions. Here he compares the different kinds of display, and points out among other important matters that not "*all* bright-coloured birds have a brilliant display as the reason for their colours"; for example, the greens of the parrots, the bizarre colours of the fruit pigeons and the brilliant hues of the kingfisher. Another point of interest is that among species with no need for concealment while breeding, the sexes are generally similar, and with this similarity goes joint action in display; and even "where the male and female differ, the plain female often seems to be anxious, as it were, to imitate the male, and only held back by circumstances from becoming like him". These are only a very few of the important and interesting matters which are referred to or discussed in this chapter or in other parts of the work.

The photographic plates illustrating the book are well chosen and for the most part excellent. The only mistakes I have noticed relate to the references to some of these plates in the final chapter (p. 124 *et seq.*).

Mr. Percy Lowe has contributed an appreciative foreword and tells us of Mr. Stonor's qualifications —his biological training, his practical experience in the Zoological Society's Gardens, his work in the British Museum (Natural History) and his field experience. There can be no doubt that this exceptional combination of circumstances has helped the author to produce an attractive book which presents the facts in simple and, for the most part, non-technical language, and yet is full of information for the sexual physiologist and the specialist in bird behaviour.

F. H. A. MARSHALL.

CHEESE-MAKING: SCIENTIFIC RESEARCH AND CONTROL

THE oldest and one of the best ways of concentrating and conserving in a palatable form a large part of the nutritive value of milk is to make cheese of it. Whilst butter contains little more than the fat of the milk, cheese contains the casein, a large proportion of the valuable mineral salts and an important part of the vitamins as well. Only a relatively small proportion of the original water of the milk—approximately 2·5–3 per cent—remains in the ripened cheese, which if it is one of the more popular types of cheese in Great Britain, may be taken as containing about a third each of animal protein, fat and water. Cheese is probably, weight for weight, the most valuable of the ordinary foodstuffs in our dietary, since neither dried whole milk nor dried skim milk are purchased, nor readily purchasable, by the ordinary consumer in Great Britain. Approximately 200,000 tons of cheese, of which about twenty-five per cent was made in Great Britain, were consumed annually in this country before the War.

But there is cheese—*and* cheese. Unimpeachable organoleptic evidence exists for the statement that even under modern conditions cheese-making is not by any means a fully controlled industrial process. It is an art, as well as an "essay in applied biochemistry and bacteriology", and an art that sometimes breaks down seriously. Of late years, however, scientific research and control have made cheese manufacture less erratic.

At a joint meeting, under Mr. E. B. Anderson's chairmanship, of the Food Group of the Society of Chemical Industry and the Society of Public Analysts held in London on December 4, some aspects of recent research on cheese quality and its control were described by Prof. H. D. Kay and three of his colleagues of the National Institute for Research in Dairying. These investigations are a small part of an extensive programme of research on cheese-making and cheese quality that was getting under way at the Institute and at various co-operating cheese-making and other centres at the outbreak of war, and in which a fairly large team of research workers including a physicist, a statistician and a psychologist were collaborating. The War has inevitably interfered seriously with this plan ; but a portion of the work, which has a direct bearing on cheese-making under war conditions, is still going on.

In an introduction by Prof. Kay this general plan was briefly outlined. Cheese is a complicated living system rather than a stable end-product, and a variety of techniques, chemical, biochemical, bacteriological, physical, physiological and psychological, are needed if the measurement and control of the many factors that go to make up cheese quality are to be satisfactorily effected. Methods for improved control of the quality of the original milk, of the cultures of lactic acid bacteria ('starters') added to promote acid production and flavour, of the enzymic characteristics of the rennet used, of the temperature and acidity of the milk and curd at various stages, of the timing of the succession of operations, of the physical properties of the curd and ripening cheese, are being considered. It is particularly necessary to define cheese quality so far as possible in precise terms, otherwise it cannot be consistently achieved.

Some recent findings on the nutritive value of various types of cheese were described in the introduction. Mr. J. Houston, who with Dr. S. K. Kon is investigating the proportion of the various vitamins of the original milk that remain in several staple varieties of cheese after different periods of ripening, has found that almost the whole of the vitamin A and carotene of the original milk remain in the cheese made from it, whether it is Cheddar, Cheshire or Stilton, and whether it is made in summer or winter.

It is not surprising that both these accessory factors, being fat-soluble, stay in the cheese, which contains practically the whole of the fat of the original milk ; but it is of considerable significance that during the four to five months of the ripening process the conditions in the cheese are such that there is no destruction of either vitamin A or carotene.

Of the vitamin B group, preliminary experiments show that vitamin B_1 is lost in the whey to the extent of about nine tenths of that present in the original milk. Of the lactoflavin (riboflavin) distinctly less—only about three quarters—appears to go into the whey. On the supposition that these two vitamins are present in simple aqueous solution, it would be expected that more than 95 per cent of each would be lost. There is now little doubt, however, that a considerable proportion of each of these vitamins—particularly riboflavin—is more or less firmly bound to the proteins of the milk which are clotted by rennet. About 10 per cent of the B_1 vitamin in the original milk, and about 25 per cent of the lactoflavin remain, therefore, in the cheese, and suffer no serious change in amount during at least four months of ripening. If anything, Stilton contains a slightly larger proportion of the vitamins than the other two varieties.

Prof. Kay also brought forward some analytical work of Dr. E. C. V. Mattick by which she has shown that there is considerable variation in the content of mineral salts as between the commoner cheeses—Cheddar, Cheshire and Lancashire on one hand, and Stilton on the other. In the making of Stilton the curd is allowed to remain in contact with the whey for a longer time than in the case of the other three cheeses. As a consequence the Stilton curd is bathed in an increasingly acid medium (owing to the bacterial fermentation of the lactose which is still proceeding rapidly in the whey). As this increasingly acid medium slowly drains away it leaches out much of the calcium and phosphorus originally present in the curd. Whilst ripe Cheddar cheese, for example, contains 57 per cent of the calcium of the original milk and 50 per cent of the phosphorus, Stilton cheese of the same age and made from a portion of the same original bulk of milk only contains 7 per cent of the calcium and 26 per cent of the phosphorus. It is nutritionally of importance in war-time that each of the three most widely consumed cheeses—Cheddar, Cheshire and Lancashire—contains an equally high proportion of calcium. Stilton, a luxury cheese, is consumed for the most part by those whose diet is unlikely to be lacking in this mineral.

Flavour in cheese is bound up, to a large extent, with the presence of fatty acids, particularly the lower fatty acids, liberated during lipolysis. Miss E. R. Hiscox dealt with developments which she and her collaborators have introduced in the methods of determining volatile fatty acids in cheese, and with the significance of some of the recent findings obtained with the new technique.

Simple steam distillation of an acidified cheese mush gives results which are far too low, since both the fat and the protein of cheese hold back appreciable amounts of some of the volatile acids. Miss Hiscox gave details of a new method of analysis which depends on water extraction of the cheese mush, followed by extraction of the separated cheese fat with very dilute alkali, ether extraction of the residues and steam distillation of the acidified extracts. A particularly interesting finding is that the blue cheeses, Roquefort and Danish Blue, are in a different class from the blue cheeses Stilton and Gorgonzola as regards their content of fatty acids, and the behaviour of the fatty acids on extraction. The former pair are highest, Stilton and Gorgonzola lowest, in their volatile fatty acid content, whilst typical Cheddar and Cheshire are intermediate. The correlation between these and other findings and flavour of the different cheeses was pointed out.

The chief chemical changes in ripening cheese are proteolysis, fermentation of the remaining lactose to lactic, acetic and propionic acids, and a certain degree of lipolysis. Dr. J. G. Davis described the part played by enzymes in these processes. He stressed the importance, from the point of view of cheese quality, of beginning with chemically normal (that is, mastitis-free) milk, and with rennet of good quality. Pasteurization (which destroyed most of the enzymes of the milk as well as a large majority of the micro-organisms) previous to cheese-making slows down ripening and prevents the attainment of the fullest flavour. It also prevents the development of certain taints and aids in the production of cheese of long keeping quality. Commercial rennet contains enzymes having at least four distinguishable activities: (*a*) clotting, (*b*) proteolysis of the pepsin type (*p*H optimum of 2), (*c*) proteolysis of the papain type (optimum *p*H about 4·6), (*d*) proteolysis of the peptidase type (optimum *p*H about 6). Nevertheless, pure rennin free from pepsin produces equally good, if not better, cheese than commercial rennet.

Two of the enzymes which normally occur in raw milk—lipase and proteinase—are concerned in cheese-ripening. The latter produces a mellowing of the body of the cheese, owing to protein breakdown, but does not seriously affect the quantity of desirable flavour substances. Lipase, on the other hand, has an important effect on cheese flavour. It has recently been found that if small amounts of lipase are added to milk, a strong and slightly rancid flavour is produced in the cheese. This flavour, called by graders a "kexey" flavour, has been known for a long time, but its origin was not previously understood. Dr. Davis stated that cheese flavour is for the most part bound up with the lipolytic enzymes, which may be inherent in the original milk or of bacterial origin. The mild flavour of cheese made from pasteurized milk, or from very clean milk; can be correlated with the absence of bacterial lipase.

Quality in cheese was also dealt with, but from an entirely different angle, by Dr. G. W. Scott Blair. He pointed out the desirability of establishing objective criteria, both for controlling the various stages in the making of cheese and in the assessment of its final quality, rather than relying entirely on subjective personal judgment, though the latter could never be entirely dispensed with. He described new methods and apparatus, devised by himself and his colleagues at Shinfield, by which certain of the rheological properties of cheese and other products can now be measured in C.G.S.

units. One of these is a simple practical apparatus for deciding when curd shall be pitched (allowed to settle), the correct timing of which is highly important from the point of view of cheese quality. This apparatus, already in use in a few cheese-manufacturing centres, gives a numerical measure of the quality of the cut curd just before pitching time, which enables this time to be decided with some precision. Dr. Scott Blair showed also another simple apparatus, recently made for measuring the 'body' of ripening (or ripe) cheese, previously assessed literally by rule of thumb (pressure) or by the use of a special skewer. He described a rather more complicated apparatus now in use by which it is possible to maintain constant pressure per unit area on a sample of material the cross-section of which is increasing, and mentioned some of the unexpected results which cheese and a variety of materials have recently given when tested by it.

APPLICATION OF X-RAYS TO THE STUDY OF ALLOYS*

BY DR. H. LIPSON,
CAVENDISH LABORATORY, CAMBRIDGE

THE use of X-rays has proved to be of fundamental importance in the investigation of alloy phase diagrams. The classical methods—cooling curves and the microscopic examination of etched surfaces—are, of course, of immense value where the problem is simply that of the precise determination of phase boundaries, and it is probable that the use of X-rays for this purpose is not of great importance. Where, however, more complex problems of equilibrium arise, the knowledge of crystal structures involved is essential.

As an example of this may be quoted the system aluminium-copper. Several investigators[1] had recorded their views on that part of the system which lies between 15 and 30 per cent aluminium; but it was first found by X-rays[2] that the problem was not one of ordinary phase equilibrium. The phases have all essentially the same crystal structure, and vary only in the way in which the two sorts of atoms are arranged on the positions available. This results in changes of symmetry[3] which are not ordinary phase changes and which do not produce regions of two-phase equilibrium. Thus the problem is not one of which the microscope could be expected to produce a solution.

For the investigation of this type of structural change it is necessary to use apparatus of high resolving power. As in certain types of optical interferometer, this is achieved by using the high orders of interference, particularly those which are scattered back almost into the incident X-ray beam. Since, however, the deviation of a particular order is fixed by the dimensions of the unit cell and the wave-length of the radiation, the only control one has over the resolution lies in the dimensions of the apparatus. Increasing distances decrease the intensity of the diffracted beams, and so the advantage of increased resolution has to be balanced against the disadvantage of increased exposure time. Progress has therefore been dependent on the improvement of X-ray tubes and X-ray film, and at the present day cameras can be used which would have been considered of fantastic size only ten years ago. At Prof. W. L. Bragg's laboratory in Manchester in 1924 a camera of diameter 2·5 cm. was used, followed by one of 5 cm. In 1926 a 'large' camera of 9 cm. diameter was introduced and was used to find the structure of γ-brass[4]. This camera was a standard instrument for many years, and in 1934 a still larger one of 19 cm. diameter was made and was used for special problems[5]. At Cambridge this has now become the standard instrument, and a camera of 35 cm. has also been used with some success[6]. With this camera it is probable that the limits of resolution for the high orders have been reached, but still larger ones may be necessary for separating the multitude of lines at low angles given by complex structures.

PHASE DIAGRAMS

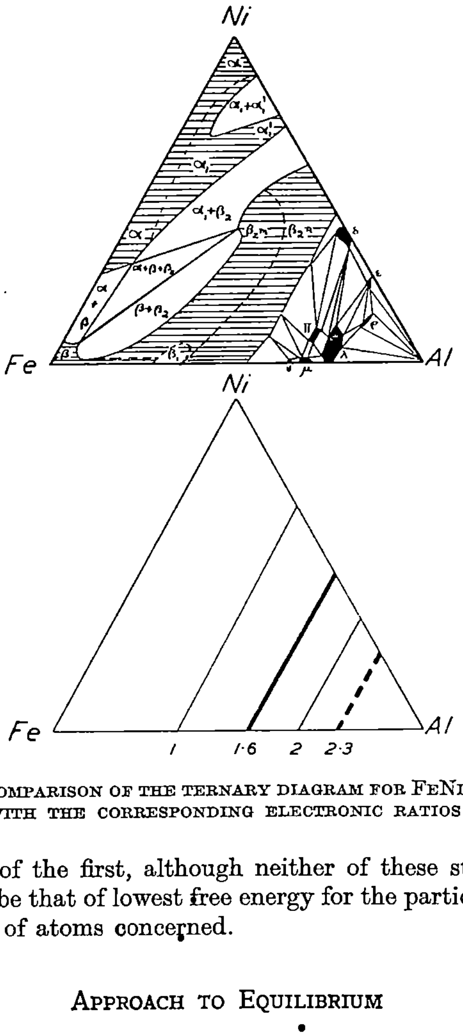
Although the most important function of X-rays must always be the determination of crystal structures, a great deal of valuable information has been obtained about the equilibrium, and approach to equilibrium, of many alloy systems. This information merely adds to the vast amount already obtained by the standard methods of metallurgy; but it is data which would be obtainable in no other way. The reason for this is two-fold. First, each phase gives its own characteristic X-ray pattern, and secondly, incomplete approach to equilibrium is usually indicated by broadening of the X-ray lines. In most binary systems the first point is not of great importance, since any method which will distinguish between an alloy which is duplex and one which is not—the only two possible equilibrium states—will give all the information needed. This, however, is not true for ternary systems ; for these a technique is needed which will distinguish the various phases. This is a difficult matter for the microscope, but falls naturally within the scope of X-rays. This explains the comparative ease with which ternary equilibrium can be studied by X-rays. The discovery of new intermetallic compounds has arisen as easily and as naturally as the discovery of new stars followed the invention of the astronomical telescope.

---

* Many references are made to the paper by Bradley, Bragg and Sykes (*J. Iron and Steel Inst.*, 141, 63; 1940) as well as to original papers. This is referred to in the footnote references as '*B.B.S.*' followed by the page number of the particular item. The diagrams are also from this paper.

Of more practical importance, however, is the study of the equilibrium of the simpler structures. The number of reflections is small, and any variations in their sharpness are easily noticed. An interesting example of this occurs in the iron-nickel system. It had been known for some time that it was difficult to produce equilibrium in certain iron-rich alloys, many of the physical properties showing hysteresis in their variation with temperature. With normal heat treatments X-ray photographs showed lines that were very blurred, but it was found that by heat treatment at low temperatures for lengthy periods much sharper lines were obtained. This gave a valuable indication of the direction of the approach to equilibrium, and two diagrams[7,8] based solely on X-ray data have recently been published. The second has perhaps departed too far from probability, but the first, although it has received some support from magnetic measurements[9], is still too simple to explain all the experimental results.

Another most interesting phenomenon occurs within this same system. Although in their equilibrium state certain alloys contain both body-centred and face-centred cubic phases, they can be maintained as single-phase alloys with a face-centred structure by quenching from high temperatures. If such a single-phase alloy be now put into liquid air, its structure changes over completely to body-centred cubic. This does not happen if the alloy is in the duplex state. At first sight it seems rather paradoxical that alloys which are so reluctant to change their structures at temperatures as high as 400° C. should be able to change so completely at $-200°$ C. The explanation lies in the difference between transformations which require migration of atoms and those which do not. The change from a single-phase state to a duplex one requires that atoms of one sort shall move from a uniform distribution in the alloy to one of greater concentration in certain crystal grains. This may involve the atoms in total movements of many atomic diameters, and this process of diffusion is helped by thermal agitation. Below a certain temperature, diffusion may be so slow that it is negligible, and a structure which is not that of lowest free energy may be 'frozen in'. The change from one single-phase structure to another, provided it does not involve complicated motions of the atoms, can take place without the help of thermal agitation, since it does not demand migration of the atoms. In this case the change can take place as soon as the temperature is such that the free energy of the second structure is lower than that of the first, although neither of these states may be that of lowest free energy for the particular ratio of atoms concerned.



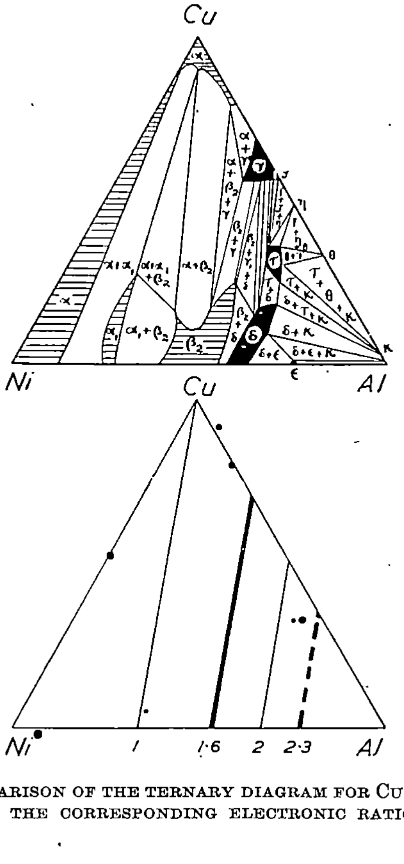
A comparison of the ternary diagram for FeNiAl with the corresponding electronic ratios.

Approach to Equilibrium

Many alloys of modern discovery have their best properties when they are not in their equilibrium states, and thus the study of equilibrium can give only an incomplete answer to the problems of metallurgy. The steels, for example, though handled with such consummate skill by the technician, still remain a closed book to the theoretician. A valuable start has, however, been made on the explanation of the properties of certain other alloys.

Perhaps the most fascinating of these studies is that of the age-hardening of aluminium alloys. The work of Guinier[10] and of Preston[11], who have used the oscillating crystal method, has shown that the atoms of the alloying element, copper, tend to precipitate out along planes in the original aluminium lattice. This effect was manifested on the photographs only by certain faint streaks which may have remained unnoticed by less meticulous workers.

Another subject which has been tackled with some success by X-rays is the Mishima permanent magnet alloy, which is essentially Fe_2NiAl. Bradley[12] has produced a very plausible theory of the origin of the strains which are the cause of the high coercivity. Some alloys in the system Fe-Cu-Ni seem to go through a similar process in the dissociation into two phases, and here it has been found possible to arrest the process at different stages, which can then be closely examined by X-rays[13]. Here again it appears that the precipitation takes place along planes, although it is on a much larger scale than in the age-hardening alloys. The work of Mott and his school[14] is contributing greatly towards the explanation of this phenomenon; but no theoretical method has yet been found for correlating these structures with the tensile strength and hardness of the alloys.



A COMPARISON OF THE TERNARY DIAGRAM FOR CuNiAl WITH THE CORRESPONDING ELECTRONIC RATIOS.

FACTORS AFFECTING THE OCCURRENCE OF STRUCTURES

Of parallel importance to the deduction of the physical properties of alloys from their crystal structures is the deduction of the crystal structure from the composition. In this, more positive results have been obtained, based on the now famous Hume-Rothery rule[15]. This points out that there is a general connexion between crystal structure and concentration of valency electrons. By valency electrons is meant those electrons in the outer shell of an atom which are not firmly bound to the nucleus; it is these electrons which give to the atom its peculiar metallic properties. Copper atoms, for example, have one such electron, zinc atoms have two, and aluminium atoms have three. The transition elements, such as iron, which have incomplete inner shells, may take extra electrons into those shells and thus cancel out the effect of their own valency electrons. Thus over large ranges of composition these elements behave as though they were nulvalent.

The valency electrons may be considered as trains of waves moving in the three-dimensional field of the nuclei. The interactions of the two may be summed up in a very neat geometrical way, using the concept of 'reciprocal space'[16]. Planes are drawn which bisect at right angles the lines joining the origin to each point of the reciprocal lattice. Those planes which are connected with strong X-ray reflections should also be connected with strong reflection of those electron beams which make the right angle with them and have the right energy. It has been shown, however, that waves of these energies are forbidden[17]. With these forbidden energies is associated a band of energies which is large when the X-ray reflection is large, and tends to zero as the reflection tends to zero. Electron states may also be plotted in reciprocal space (it is in this case usually called *k*-space), and the effect may be interpreted as a reduction of energy for those states which lie just within the planes, and an increase for those which lie just outside.

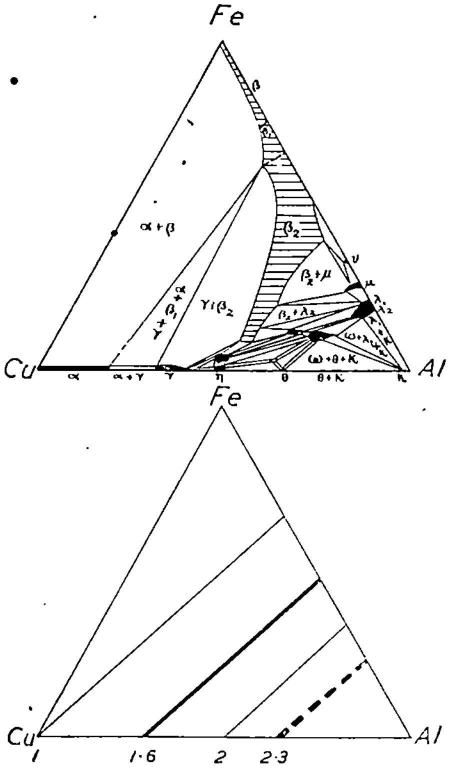
The planes outline zones called 'Brillouin zones', and the volumes of these give the numbers of electrons per atom which they can contain. These numbers are of importance only when the highest occupied electronic states are in the neighbourhood of the surface of a Brillouin zone. This is not the case for a monovalent metal such as copper, and the structure is fixed by other considerations. The first Brillouin zone for the face-centred cubic structure of copper is very uneconomic for holding more electrons, however, as some of its faces are much closer to the origin than are others. Thus, if electrons are added, for example, by adding zinc, the electronic states must either overlap into the second zone or spread out along the surface of the first zone. Both these processes involve rapid increases of energy, in the first case, because of the energy discontinuity, and in the second, because the states occupied quickly become farther from the origin. Thus, another structure may be favoured. The body-centred cubic structure has a Brillouin zone of which the faces are farther from the origin than are those of the face-centred cubic structure. More electrons can therefore be added before the rapid increase of energy occurs, and so the occurrence of this structure in the copper-zinc system is accounted for. When the electronic states reach the boundary of this zone another adjustment may be made. The atoms are rearranged in such a way[4] that they give a Brillouin zone which is almost spherical. Thus the last electrons added are in states of depressed energy, since they must all be near the boundary.

After this stage has been reached in the copper-zinc system, the electrons give up the attempt to confine themselves in the first Brillouin zone, and quite different structures follow. In the copper-aluminium system, however, the electrons make a last desperate attempt to confine themselves within the zone. The number of atoms per unit cell is reduced as electrons are added, and the number of electron states occupied in each Brillouin zone remains practically constant[18]. The same device is resorted to in the body-centred phase field of the aluminium-nickel system, and this results finally in a rhombohedral deformation of the structure[19]. Direct experimental support for these ideas is given by the fact that in the aluminium-copper-nickel system the effects are extended along lines of constant electron concentration[20].

The theory can give a rough estimation of the phase boundaries in systems which contain the structures mentioned above, and quite good agreement with experimental results is found. Moreover, the frequent occurrence is accounted for of complicated structures based on the body-centred cubic structure, whereas those based on the face-centred structure are very rare.

The importance of electron concentrations in ternary alloys is illustrated in the accompanying illustrations, which show a comparison of the important features of three ternary systems with their lines of constant electron concentration[21]. The lines of 1·6 and 2·3 electrons per atom are shown, and it will be seen that these lines coincide roughly with the limits of the body-centred cubic phase fields, and of the complicated structures, respectively.

From all these facts it seems fairly certain that the Brillouin zone theory must form the main basis of the study of equilibrium in alloy systems, and further attention must be directed to those factors which govern the finer detail of the diagrams. This, unfortunately, is not likely to yield any immediate results, as it requires a method of calculating the free energies of different structures, but in any event, one can say that there is no lack of raw material for the theoretical physicist.



A COMPARISON OF THE TERNARY DIAGRAM FOR FeCuNi, WITH THE CORRESPONDING ELECTRONIC RATIOS.

---

[1] '*B.B.S.*', 90.

[2] Westgren, *Trans. Amer. Inst. Min. Met. Eng.*, Inst. Met. Div., 13 (1931).

[3] Bradley, Goldschmidt and Lipson, *J. Inst. Met.*, **63**, 149 (1938).

[4] Bradley and Thewlis, *Proc. Roy. Soc.*, A, **112**, 678 (1926).

[5] Bradley and Lu, *Z. Krist.*, A, **96**, 20 (1937); '*B.B.S.*', 71.

[6] Lipson and Petch, *J. Iron and Steel Inst.*, 1940 (in the Press).

[7] Owen and Sully, *Phil. Mag.*, **27**, 614 (1939).

[8] Bradley and Goldschmidt, *J. Iron and Steel Inst.*, **140**, 11 (1939); '*B.B.S.*', 90.

[9] Pickles and Sucksmith, *Proc. Roy. Soc.*, A, **175**, 331 (1940).

[10] Guinier, *C.R.*, **206**, 1641 (1938). Calvet and Guinier, *C.R.*, **206**, 1972 (1938).

[11] Preston, *Proc. Roy. Soc.*, A, **167**, 526 (1938); *Phil. Mag.*, **26**, 855 (1938).

[12] Bradley and Taylor, NATURE, **140**, 1012 (1937).

[13] Bradley, *Proc. Phys. Soc.*, **52**, 80 (1940); '*B.B.S.*', 112.

[14] Mott, Physical Society Reports on Progress in Physics, **6**, 207 (1940).

[15] Hume-Rothery, "The Metallic State", 328 (Oxford, 1931).

[16] Bernal, *Proc. Roy. Soc.*, A, **113**, 117 (1926).

[17] Mott and Jones, "The Theory of the Properties of Metals and Alloys", 58 (Oxford, 1936).

[18] Konobeevsky, *J. Inst. Met.*, **63**, 161 (1938).

[19] Bradley and Taylor, *Phil. Mag.*, **23**, 1049 (1937).

[20] Lipson and Taylor, *Proc. Roy. Soc.*, A, **173**, 232 (1939).

[21] '*B.B.S.*', 100.

AIR RAID DAMAGE

University of London

UNIVERSITY COLLEGE. Some details have already been published in the Press regarding the very serious damage done to the College buildings. The main damage is to the original building and, in particular, to the Library, in which about a 100,000 books have been destroyed. All Faculties of the College remain evacuated.

KING'S COLLEGE. A high explosive bomb fell in the quadrangle, but the damage was less severe than might have been expected. The College had already been evacuated.

WESTFIELD COLLEGE. Incendiary bombs have done damage which is, however, not serious; the College remains evacuated.

BIRKBECK COLLEGE. Very serious damage has been done by fire resulting from incendiary bombs. Three laboratories were completely gutted and a fourth severely damaged and a considerable portion of the roof of the theatre destroyed. The main building suffered also from water. The College, however, continues to function.

SCHOOL OF ORIENTAL STUDIES. Some damage, not considerable, was done to the new building from a high explosive bomb.

GOLDSMITHS' COLLEGE. The buildings have been damaged twice and partly wrecked.

MEDICAL SCHOOLS: *St. Bartholomew's:* severe damage has been done to that part of the College which adjoins the hospital. Later, the roof of the College Hall in Charterhouse Square was destroyed by incendiary bombs, and considerable damage was caused by water. *St. Thomas's:* very severe damage has been done, but work is continuing. *Guy's:* headquarters and also school properties at Tunbridge Wells have been damaged. *London:* damage has been done to the Dissecting Room, the Bacteriological Department and Students' Hostel. *London School of Medicine for Women:* damage has been done by incendiary bombs, particularly to the Anatomy Department; other departments damaged by water. Students' Hostel severely damaged by blast.

Royal College of Surgeons

BLAST has broken all the windows and window frames on the north front of the Royal College of Surgeons, torn off doors inside the building and shattered many of the roof lights in the Museums. No structural damage was done except to two partition walls on the fourth floor, which houses the work rooms for the Museum. In the Library Reading Room, little damage was caused. Books and periodicals were found in the College forecourt and on the roadway outside. Broken glass and soot covered the periodical tables and lay thickly all over the floor. Careful cleaning of the books and periodicals was started by the staff and, within a day, the reading room, although windowless, was in use again. Ceiling and shelves damaged by the blast were repaired rapidly and the window openings boarded up. The Museum damage was relatively slight. In Room I, some of the shelving on which is housed the craniological collection collapsed and about twenty skulls were damaged, but most of them not irreparably. Anatomical specimens, also in the wall cases, escaped major damage. Specimen jars were cracked or broken, but no specimens were lost. Room V and the War Museum have also been damaged. Roof lights in Room V were broken and most of the windows of the War Museum were smashed. About one hundred specimen jars were either broken or cracked, but all the specimens were retrieved and identified.

Precautions which had been taken to protect the Museum specimens worked admirably. Historic specimens and a complete series of pathological material suitable for medical students were stowed in a safe place almost two years ago, the idea being, that if the remainder of the Museum were destroyed, its connexion with John Hunter and his work would be preserved, and its usefulness to coming generations of students would remain unimpaired. Arrangements are now being made to remove at least the whole of the Periodical Collection in the Library to a safe place, so that, in the event of further air activity, at least one large series of medical periodicals would remain intact. The laboratories of the College suffered little damage beyond broken windows and wood frames, but as a precautionary measure the laboratories are being moved out of London.

Museum of Practical Geology

THE office block has been hit by a high explosive bomb. Two office rooms were damaged and about a quarter of the windows of the building were broken, together with others in surrounding buildings. Little damage was done to material in the Museum.

Royal Observatory, Greenwich

THE Observatory has been damaged by high explosive and incendiary bombs. The revolving globe and observatory clock and parts of the telescope room were damaged, but the time ball continues to function.

University of St. Andrews

MOST of the windows of one side of the University Library have been broken and damage has been done to books, especially those in the Science Reading Room. One wall of the new building housing the Departments of Botany and Geology has been seriously damaged, and the Bute Medical Buildings were also affected, much damage being done by the breakage of skylights and windows.

University of Manchester

THE University and the College of Technology have suffered certain damage.

NEWS AND VIEWS

Pitfalls of the Tannic Acid Treatment of Burns

IN the past several months opportunities for testing the tannic acid treatment of burns have been only too abundant, and the method, which was highly commended at the start of the War, has not emerged from the tests so successfully as had been expected. The Minister of Health recently stated in the House of Commons that tannic acid is not satisfactory for certain types of burns and more definite statements had previously been made by authoritative speakers in the course of a discussion at a meeting of the Royal Society of Medicine. Thus, Rear-Admiral C. P. G. Wakeley said that no tannic acid preparation must be used on burns of the hands or face, and he gave ample reasons for this opinion. Mr. A. H. McIndoe said the local treatment of war cases has shown that coagulation treatment, especially by tannic acid, has been carried too far. So overwhelming is the evidence that this method is fraught with great danger when applied to burns of the hands and face, that first-aid posts have been officially instructed not to use tannic acid in the treatment of them.

It might be a wise course to advise the public generally of these dangers since hundreds of thousands of tannic acid preparations were bought by them in the early stages of the War, before experience had shown the defects of the treatment. The use of tannic acid in the treatment of burns is a comparatively recent innovation; it was first described in 1925. The rationale of the treatment is based on two factors as explained by Dr. Ethel Browning in "Modern Drugs in General Practice" as follows: (*a*) its precipitation of tissue proteins, with formation of a coagulum which prevents absorption of toxins, and (*b*) the analgesic and protective covering afforded by this coagulum.

Galapagos: a Zoological Landmark

IN September 1835 Charles Darwin landed on the Galapagos Islands, and twenty-four years later the "Origin of Species" was published. The two events are linked together, almost as cause and effect, in the history of the theory of evolution, for, according to Darwin himself, the conception of the "Origin of Species", and all that it meant in revolutionizing the outlook of men, lay away back in that month's visit to the Archipelago. It was a touch of inspiration that suggested to William Hunter and David Lack that the sort of evidence which appealed to Darwin might be embodied in a cinematograph film of the Islands and their characteristic vegetation and animals. Their film, "Galapagos", produced by the Dartington Hall School Film Unit, is a novel and notable instrument for bringing realism to many biological truths the evidence of which students often find it difficult to appreciate. The zoning of plants and animals is illustrated by the waterless and porous lava formations of the low grounds with xeprohytic vegetation and scanty fauna, and by the rain-forest of the misty uplands; the effect of isolation, by endemic animals showing various degrees of distinctiveness from their mainland ancestors. An outstanding example of adaptive radiation is illustrated by the ground-finches, six different types of which range from the normal seed-eater to the remarkable Cactospiza, which is seen digging insect larvæ from their lairs by means of a twig—a tool-using bird.

Darwin paid much attention to the unique reptiles of the islands and they are here well shown, the land and sea-lizards and the giant tortoises, although we should have appreciated a comparative picture of some of the different island forms of the tortoises which so much impressed the naturalist of the *Beagle* and Mr. Lawson, who first pointed them out to him. The zoologist will see many other good teaching points in this valuable film, the photography of which, made during the Lack-Venables Galapagos Expedition of 1938–39, is of the highest standard. Indeed "Galapagos" should be part of the teaching outfit of every department in university and secondary school which is endeavouring to impart the essential truths of zoology. It is a two-reel, 16-mm. film, occupies half an hour, is accompanied, although it is fully captioned, by teaching notes, and may be hired at a moderate rate from the Dartington Hall Film Unit, Totnes, South Devon.

Recent Earthquakes

A STRONG earth tremor with epicentre probably near Pwllheli in North Wales was felt at about 10.20 p.m., B.S.T. on December 12. The shock caused some apprehension in the town, where it rattled windows and shook floors, though no damage or casualties have been reported. The tremor was felt in Pwllheli, Conway, Carnarvon, Bangor, and also in Anglesey, and is said to have lasted about forty-three seconds. Two slight aftershocks have been reported, the first about three minutes after midnight on December 13, and the second about forty minutes later. The strong earthquake in the same area on June 19, 1903, which was preceded by a slight foreshock, was stated by the late Dr. C. Davison to have been a simple shock with the innermost isoseismal area about 33·5 miles by 15 miles, and connected with movement along the Aber-Dinlle fault. It was followed by thirty-three aftershocks, and another tremor associated with this fault occurred in 1906. Other minor disturbances have occurred in Carnarvonshire since, of which two may be mentioned. The disturbance of April 14, 1931, in south Carnarvonshire, which was attributed at the time to earth tremors, was afterwards shown to be due to a meteor which fell in the district. On January 13, 1932, there was a small tremor in south Carnarvonshire, but it was not recorded by seismographs.

Two earthquake shocks occurred at Glaruo in Switzerland at 9 a.m. and 2.30 p.m. local time on December 12. The only information available at present is that the latter shattered some houses.

Catalogue of Meteorites of the U.S.S.R.

THE scientific secretary of the Meteorite Committee of the Academy of Sciences of the U.S.S.R., Mr. L. A. Kulik, has prepared for publication a catalogue of meteorites of the U.S.S.R., which is to appear in an early issue of the Soviet publication *Meteoritika*. Up to November 1, 1939, ninety-five meteorites were counted as having been found on territory of the U.S.S.R. With the inclusion of the newly acquired territory of Western Ukraine and Western Belorussia and the Baltic republics, this number has now been increased to 112.

The Academy of Sciences of the U.S.S.R. has one of the largest collections of meteorites in the world, numbering ninety-three specimens found in the Soviet Union and fifty-five specimens which have fallen in other countries. The aggregrate weight of the Academy's collection is 4,189 lb. The collection includes some unique specimens, of which the most valuable is the 'Pallas Iron'. This is the largest meteorite in the U.S.S.R., weighing more than half a ton. It was found on the banks of the River Yenisei in 1749, and in 1771 was brought to St. Petersburg by Pallas.

Although at that time science denied the possibility of stones falling to earth from cosmic space, Pallas was convinced that the iron mass he had brought to St. Petersburg was a meteorite. The 'Pallas Iron' laid the foundation for the meteorite collection of the Russian Academy of Sciences. The second remarkable meteorite in the Academy's collection is the 'Boguslavka'. This is the largest iron meteorite in the world observed falling by eye-witnesses. The 'Boguslavka' meteorite fell on October 18, 1916, in the Far Eastern districts of Russia. It is in two parts, weighing 439 lb. and 121 lb. respectively. Another remarkable iron meteorite in the collection is one which is streamlined and shaped like the nose of a shell. The 'Pallas Iron' and 'Boguslavka' meteorites with a number of others are on view at the Karpinsky Geological Museum of the Academy of Sciences of the U.S.S.R.

Mortality in 1940

THE July issue of the *Statistical Bulletin* contains a study of the mortality of the first six months of 1940 of the many millions of men, women and children insured in the Industrial Department of the Metropolitan Life Insurance Company, New York. It shows that the record of the individual causes of death contains both favourable and unfavourable items. For each of the diseases typhoid fever, measles, scarlet fever, whooping cough, diphtheria, pneumonia, tuberculosis, diarrhœal diseases, appendicitis and puerperal conditions, the indications are that mortalities for 1940 will be lower than ever before. The same is true of homicides and all kinds of accidents combined. The greatest single achievement is reduction in a single year of 22 per cent in the mortality from pneumonia. Unfavourable aspects, on the other hand, are the continued rise in the mortality-rates from cancer, diabetes and diseases of the coronary arteries.

Origin of Cosmic Rays

AN interesting note appears in *Electrotechnics* of September, telling of the visit of Prof. R. A. Millikan and his colleagues Dr. H. V. Neher and Dr. Pickering, of the California Institute of Technology, to the Indian Institute of Science at Bangalore last January. Bangalore was one of three places in India chosen by Prof. Millikan for carrying out measurements on cosmic rays. These experiments form a part of a series conducted by him which it is hoped will yield valuable data regarding the source of cosmic rays and their precise function in the working of the universe. Results so far obtained seem to confirm his hypothesis about the behaviour of the rays and his suggestion that they create atoms of helium, oxygen, silicon and iron, and are in fact replenishing the earth's diminishing supplies of these elements almost as fast as they are used up. At the invitation of the council of the Indian Institute of Science, Prof. Millikan arranged a series of four lectures for the benefit of workers in the Institute. Of these four lectures, the first and the last were delivered by Prof. Millikan himself. In the first one he traced the history of our knowledge of cosmic rays up to the present day. The second and third lectures were given by Drs. Neher and Pickering respectively, and they dealt with the technique of measurement of cosmic rays. In the concluding lecture, Prof. Millikan gave a critical survey of the various existing theories regarding the origin and nature of cosmic rays.

Canadian Seismological Stations

ALL seismological stations in Canada now come within the jurisdiction of one department, with the Dominion Observatory at Ottawa as the Central Station (*Earthquake Notes*, 12, Nos. 1 and 2, Sept. 1940). There are seven stations besides Ottawa, and several improvements have recently been made. The Victoria station is now in the Dominion Astrophysical Observatory, where a vertical Wiechert seismograph and improved Milne-Shaw instruments are in operation. At Saskatoon two horizontal Mainka seismographs are in operation, whilst at Toronto the two Milne-Shaw seismographs have been improved by mirror replacements. The Kirkland Lake station commenced operation in December 1939 with a standard geophone and special recorder made by the Heiland Research Corporation. The Shawinigan Falls station employs a Wood-Anderson seismograph, whilst the Seven Falls station has Wood-Anderson and Milne-Shaw seismographs. The Halifax station has been entirely re-equipped. The Mainka instruments have been discarded and the station has now photographic recording Bosch seismographs formerly at Ottawa. Ottawa discarded the Wiechert vertical seismograph and installed

Benioff short- and long-period vertical seismometers in addition to the two Milne-Shaw instruments. The Canadian Broadcasting Corporation now transmits the Dominion Observatory noon time signals over the entire Canadian network, so that accurate timing is possible at all the seismograph stations. Seismograms from all the Canadian stations are now sent to Ottawa for analysis and interpretation, and the results published in the *Monthly Bulletin* issued by the Dominion Observatory.

Scientific Equipment and the Laboratory

In the *Nivoc Supplement* (edited and published by Messrs. W. and J. George, Ltd.—F. E. Becker and Co., London and Birmingham, No. 17, July 1940) the importance of up-to-date scientific equipment in, and correct planning of, a laboratory is stressed. Facilities for research and scientific control and testing have become an essential part of manufacturing organizations. Particularly is this so in the case of companies supplying materials to the aircraft industry, since the progress of aeronautical development is largely dependent upon the development of improved materials, both for air-frames and engines, and a very high standard of material testing and inspection has been set up. It is therefore necessary for the supplier of materials to maintain adequate research and testing establishments staffed with competent personnel. Messrs. George have recently equipped new laboratories for High Duty Alloys, Ltd. New buildings, designed by Colonel A. L. Abbott, house eleven different laboratories and departments in addition to a library and lecture theatre, and are considered to be an outstanding example of modern laboratory planning and furnishing. Teak bench tops are strongly advocated for general use. A brief note is given on the Burma teak forest and methods of exploitation, the information having been made accessible by the High Commissioner for India.

Cancer Research

In order to ensure opportunities for the publication of the scientific results of cancer research, a group of representatives of interested organizations are to co-operate in making possible a new journal *Cancer Research*, to be devoted to articles and abstracts of articles having to do with cancer research. This journal is sponsored by the American Association for Cancer Research, the Anna Fuller Fund, the International Cancer Research Foundation, and the Jane Coffin Childs Memorial Fund for Medical Research. It is hoped to start publication with the issue of January, 1941. Manuscripts should be addressed to the Secretary of the Editorial Committee, 333 Cedar Street, New Haven, Connecticut. Subscriptions are now being received at the office of the Business Manager, American Oncologic Hospital, 33rd Street and Powelton Avenue, Philadelphia. Annual subscription, one volume of twelve issues per year, will be: to members of the American Association for Cancer Research, five dollars; to non-members, seven dollars.

Announcements

As president of the Royal Society, Sir Henry Dale becomes *ex officio* a member of the War Cabinet Scientific Advisory Committee under the chairmanship of Lord Hankey. Sir William Bragg, at the special request of Lord Hankey, will remain a member of the Committee until next October, when he will have completed a year of service with it.

Dr. J. Hutchinson, keeper of museums of botany, Royal Botanic Gardens, Kew, has been awarded the Loder Rhododendron Cup of the Royal Horticultural Society.

Prof. W. M. Smart, regius professor of astronomy in the University of Glasgow, has been appointed Halley Lecturer at Oxford for 1941.

Prof. G. Pólya, formerly professor of higher mathematics in the Technical High School, Zurich, has joined the Department of Mathematics in Brown University.

In moving the second reading in the House of Commons of the War Damage Bill, Sir Kingsley Wood, Chancellor of the Exchequer, announced that whereas the general charge on buildings, etc., would be at the rate of 2*s.* in the pound on the annual value, that on institutions for the advancement of education, science or research would be at the rate of 8*d.* in the pound. Agricultural properties are to pay 6*d.* in the pound, and hospitals and churches are exempted from payment.

The title of professor of physics as applied to medicine in the University of London has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital (Free). The following have been awarded the degree of D.Sc.: Mr. J. H. Burgoyne (Imperial College of Science and Technology); Mr. S. L. Cowan (University College); Mr. C. H. Johnson (University College); Mr. R. W. B. Pearse (Imperial College of Science and Technology); Mr. M. J. D. White (University College); Mr. J. G. King, an external student. The Sir John William Lubbock Memorial Prize in mathematics for 1940 has been awarded to Mr. M. G. Pimputkar, of University College.

Applications for fellowships under the Finney-Howell Research Foundation, Inc., for 1941 must be made by January 1. This Foundation was provided for in the will of the late Dr. George Walker of Baltimore for the support of "research work into the cause or causes and the treatment of cancer". Fellowships carrying an annual stipend of 2,000 dollars are awarded for a period of one year, with the possibility of renewal up to three years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship. The address of the Foundation is 1211 Cathedral Street, Baltimore, Maryland.

In Nature of December 7, p. 743, reference was made to the jubilee of the City and South London Railway. We regret to learn, however, that the details of reconstruction work given in the second paragraph refer to the Waterloo and City Railway.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Diffuse Reflections on Laue Photographs

Sir C. V. Raman and P. Nilakantan, having first of all in NATURE[1] described the appearance of diffuse spots and streaks on Laue photographs as "a new type of X-ray reflection", now claim[2] that they were justified in ignoring all previous experimental and theoretical work on the subject. Their claim, however, cannot be admitted. Preston's photographs[3] of aluminium, sodium chloride and magnesium oxide, at room temperatures and at 500° C., were beautifully clear and typical of the phenomenon, whether his theory be accepted or not, while his photographs taken with monochromatized radiation proved beyond a doubt that the diffuse spots were due to the characteristic part of the beam. A further purely experimental paper, which pre-dates the work of Raman and Nilakantan, is that of Jean Laval[4], "Étude Experimentale de la Diffusion des Rayons X par les Cristaux", which is a most comprehensive study of the phenomenon using ionization spectrometer methods.

Nor can the previous theoretical work, whether of Brillouin[5], Faxén[6], Waller[7], Preston[3] or Zachariasen[8], be so lightly dismissed. Raman and Nilakantan state that certain limited observations on diamond "wholly exclude any explanation of these reflections in terms of the diffuse thermal scattering of X-rays". Yet Preston showed that at elevated temperatures the intensity and size of the diffuse spots given by aluminium, sodium chloride and magnesium oxide are remarkably increased, and that some new spots appear that were not previously visible, while the Laue spots suffer a corresponding diminution in importance; he also found a slight increase in the effect for diamond. Laval observed and measured a marked temperature enhancement of the effect in the case of potassium chloride, while Raman and Nilakantan[9] observed the same for sodium nitrate.

In this laboratory we have taken many photographs at liquid air temperatures, and have found that for potassium chloride, sodium nitrate, calcium carbonate and every organic compound so far examined the diffuse reflections have either almost or completely disappeared at $-180°$ C., while the Laue spots have increased in definition and number. It is true that for diamond alone the diminution of intensity at liquid air temperatures is slight, but on the other hand the characteristic temperature of diamond is exceptionally high (2340° A.), and a change of temperature of 200° is relatively unimportant. These temperature changes are completely reversible in every case, and are so striking that it seems unnecessary to suppose the phenomenon to be anything but a temperature effect, although the exact manner in which the thermal movements of the particles are related to the structure and to the elastic constants of the crystal is still a matter for further theoretical investigation.

The empirical formula which Raman and Nilakantan[10] have given for diamond, $\lambda^* \sin(\theta + \varphi) = \lambda \cos \varphi$, where θ, φ are the glancing angles of incidence and reflection with respect to the crystal planes of which λ^* is the spacing, is identical with the simple formula given by Faxén in 1923[6], a $(\sin \theta + \cos \theta \tan \theta_1) = \lambda$, where a and θ_1 have the same significance as λ^* and φ. This simple formula, however, though it may apply approximately in certain cases, was never intended to be generally applicable. It occurs, but again only as an approximation, in Waller's more complete exposition of the effect of thermal vibration of atoms in a crystal on X-ray scattering[7]. This effect is dependent upon the elastic constants of the crystal, and the theory cannot be fully tested unless these are known; but in principle the effect of thermal vibration in reducing the atom-factors, of which the theory of diffuse thermal scattering is a necessary corollary, is universally accepted[11].

KATHLEEN LONSDALE.

Davy Faraday Laboratory,
Albemarle Street,
London, W.1.

---

[1] Raman and Nilakantan, NATURE, **145**, 667 (1940).

[2] Raman and Nilakantan, NATURE, **146**, 686 (1940).

[3] Preston, *Proc. Roy. Soc.*, A, **172**, 116 (1939).

[4] Laval, *Bull. Soc. Française Min.*, **62**, 137 (1939).

[5] Brillouin, *Ann. Phys.*, **17**, 88 (1922).

[6] Faxén, *Z. Phys.*, **17**, 266 (1923).

[7] Waller, *Z. Phys.*, **17**, 398 (1925); dissertation, "Theoretische Studien zur Interferung- und Dispersionstheorie der Röntgenstrahlen". *Uppsala Univ. Arsskrift.*

[8] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).

[9] Raman and Nilakantan, *Proc. Ind. Acad. Sci.*, **11**, 405 (1940).

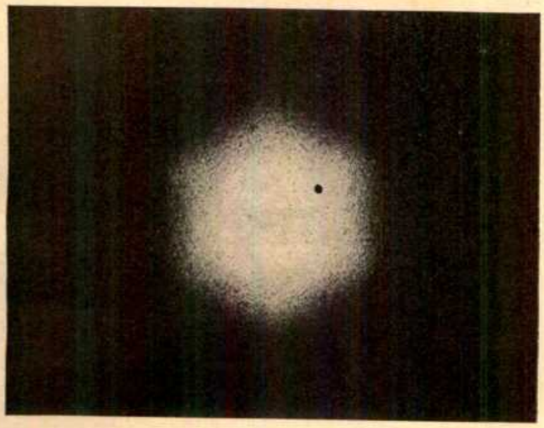
[10] *ibid.*, p. 393.

[11] Waller and James, *Proc. Roy. Soc.*, A, **117**, 214 (1927); "Int. Tabellen zur Bestimmung v. Kristallstrukturen", **2**, 559 (1935).

Grinding and Scratching Crystalline Surfaces

IT is well known that the orientations with respect to the crystalline axes of the facets of the etch figures on a basal plane of quartz can be used to locate the *a* axis of the quartz. De Gramont[1] has described a convenient method by which this may be done. A face of the specimen parallel to the etched surface is polished and a point source of light is viewed through the specimen normally to the etched surface. A pattern, consisting of spots of light, is formed, due to refraction at the facets of the etch figures, and the orientation of these facets, relative to the crystal lattice, may be found from the positions of the spots of light.

This method of studying a surface broken up into a large number of small facets of various orientations can be applied to the study of the ground surfaces of transparent materials, and yields interesting results with crystals. Thus, if a (0001) plane of quartz is ground, instead of etched, and viewed in a manner similar to that used by de Gramont, a refraction pattern of the type shown in the accompanying reproduction is seen. The intensity distribution over the pattern can be interpreted in terms of the orientations of the facets formed on the surface in the process of grinding, and in terms of the extent to which facets of any specified orientation occur.



A density analysis of the above photograph, made by the 'sharp outline' method described by Dobson, Griffith and Harrison[2], shows that preferential fracture of the quartz takes place on planes belonging to the zones $(1\,0\,\bar{1}\,l)$. The diameters of the hexagon bisect the angles between the a axes, and hence the pattern can be used to determine these axes even when the quartz crystal does not possess natural faces.

Refraction patterns have also been obtained for ground surfaces parallel to other planes of quartz than the (0001) plane, and for ground surfaces of calcite, selenite, rock salt, etc., and for surfaces of these crystals on which a large number of parallel scratches is made.

Generally, any marked cleavages possessed by a crystal are apparent in the refraction patterns of ground or scratched surfaces of the crystal. The refraction patterns are not, however, entirely explicable in terms of the usually observed cleavage planes, but lead to the assumption of a number of zones of easy fracture. The patterns formed on scratched surfaces depend to some extent on the direction of scratching, as well as on the surface of the crystal which is used.

The results obtained can in some cases be partially confirmed by microscopic examination of the ground or scratched surfaces.

R. S. RIVLIN.

Research Laboratories of the
General Electric Company, Ltd.,
Wembley.
Nov. 18.

---

[1] de Gramont, A., "Recherches sur le Quartz Piezoelectrique". (Editions de la *Revue d'Optique Theorique et Experimentale*, 1935.)

[2] Dobson, G. M. B., Griffith, J. O., and Harrison, D. N., "Photographic Photometry" (Oxford, 1926), p. 42.

Electron Diffraction Intensities

Yearian[1] and Lark-Horovitz[2] have explained certain anomalies in the intensities of the rings in electron diffraction patterns of zinc oxide on the assumption of atomic distortion. It is, however, implicit in their calculations that extinction of the electron beams owing to inelastic scattering has an equal effect on all diffractions; this would not seem to be the case.

It has been shown both with the microscope[3] and by electron diffraction[4] that the structure of zinc oxide coagulated from an ærosol consists partly of very thin filaments, and that it is these that are mainly responsible for the diffraction of electrons. The sharpness of the $(00.l)$ as compared with the $(hk.0)$ diffractions shows that the crystals are longest along their c axes, which presumably coincide with the axes of the filaments. Thus the depth of crystals to be penetrated by an electron beam is greater along the c axis than along the a or b axis, and consequently greater extinction results. Fewer crystals will be small enough to transmit electrons along the c axis than can do so along the a or b axis. In this way the intensities of the $(hk.0)$ diffractions should be reduced as compared with those of the $(00.l)$ diffractions, as is observed experimentally.

Experiments with suitably evaporated metal films[5] have shown good agreement between calculated and observed diffraction intensities, and in these cases the ring-breadths give no indication of rod- or plate-shaped crystals. It seems to me that variations in extinction due to irregular crystal shape or to anisotropy will explain at least qualitatively many of the observed differences between calculated and observed electron diffraction intensities.

S. FORDHAM.

24 Ardrossan Road,
Saltcoats,
Ayrshire.
Nov. 21.

---

[1] Yearian, *Phys. Rev.*, **48**, 631 (1935).

[2] Cf. Thomson and Cochrane, "Theory and Practice of Electron Diffraction" (London: Macmillan, 1939).

[3] Whytelaw-Gray, Speakman and Campbell, *Proc. Roy. Soc.*, A, **102**, 604 (1923).

[4] Finch and Fordham, *Proc. Phys. Soc.*, **48**, 85 (1936); also Finch and Wilman, *J. Chem. Soc.*, 751 (1934).

[5] Thomson, G. P., *Proc. Roy. Soc.*, A, **125**, 352 (1929); also Mark and Wierl, *Z. Phys.*, **60**, 741 (1930).

Increase of Heavy Potassium in Plasma

IN a previous communication[1] we described results of investigations on the isotopic constitution of potassium in normal and tumour tissue from the rat. It was shown that the percentage of the heavy isotope, $^{41}_{19}\mathrm{K}$, in potassium present in bone-marrow and Jensen sarcoma differed slightly from that in mineral potassium, being higher in the former case, lower in the latter.

Similar investigations have since been carried out on potassium in the blood plasma of normal rats. Five plasma samples were tested, each being a mixture obtained from an equal number of males and females; the animals numbering 2–12 had an average weight between 155 and 220 gm. The blood, taken by heart puncture, was added to a sodium citrate solution and centrifuged immediately. The ash of the citrate-plasma was used for the mass-spectrographic measurement.

The results showed that the content of $^{41}_{19}$K in plasma potassium was distinctly higher than in mineral potassium contained in ordinary potassium chloride (A.R.). The average increase was 2·5 per cent, the individual figures varying between 1·8 and 3·2 per cent. This increase was of the same order as that found in potassium from bone-marrow. Since potassium from all normal tissues other than bone-marrow has shown a $^{41}_{19}$K content close to that of mineral potassium, it appears that the assimilation of potassium by the cell is connected with an isotope effect. A kinetic mechanism, concerned with the movements of $^{39}_{19}$K and $^{41}_{19}$K atoms, can be devised to account for this effect.

A. LASNITZKI.

Cancer Research Department,
University, Manchester.
Department of Physiology,
University, Birmingham.

A. K. BREWER.

Bureau of Plant Industry,
U.S. Department of Agriculture,
Washington, D.C.
Nov. 28.

[1] Lasnitzki, A., and Brewer, A. K., NATURE, 142, 538 (1938).

Nature of the Feulgen Reaction with Nucleic Acid

THROUGH the courtesy of Messrs. Barber and Price I have now seen particulars of the tests referred to in their criticism[1] of my note[2] on the nature of the Feulgen reaction with nucleic acid. It is obvious from their account that they have failed to see the main point of my suggestion, that is, that polymerization, via a nitrogen linkage, between leuco-base of fuchsine and the purines available in hydrolysed chromatin is just as likely to result in a coloured product as the similar polymerization between aldose and leuco-base via an oxygen linkage. Their experiments, though apparently made in good faith, were mainly concerned with certain elementary details of the Feulgen reaction which have no bearing on my suggestion.

C. S. SEMMENS.

Department of Cytology,
King's College,
at the
University of Bristol.
Nov. 8.

[1] Barber, H. N., and Price, J. R., NATURE, 146, 335 (1940).
[2] Semmens, C. S., NATURE, 146, 130 (1940).

MR. SEMMENS' "suggestion" that purines available in hydrolysed chromatin might be responsible for Feulgen staining was quite clear to us, and it was to test it that we re-examined the behaviour of certain purines with the Feulgen reagent. Since these experiments were a repetition of Semmens', their bearing on the point in question should be sufficiently clear to him. We consider his suggestion untenable because our tests, contrary to his, show that purines do not give any colour with the Feulgen reagent.

The reason we repeated these experiments was that they led to a grave theoretical difficulty, namely, that yeast nucleic acid and thymonucleic acid, which have the same purine components, give a different Feulgen reaction. This difference we consider (in agreement with the general view) as due to the different carbohydrate components of the two acids.

H. N. BARBER.
J. R. PRICE.

John Innes Horticultural Institution,
Mostyn Road, Merton Park,
London, S.W.19.
Nov. 8.

Mind and Matter

MAY I say how touched I am by the spirit with which your reviewer, F. S. Marvin, points the moral "that mind and not matter rules the world"[1]. I also was taught to believe that mind came first, and I should naturally prefer to retain a conviction which has been sufficient for so many generations of historians and philosophers. But admittedly, the bearing of this observation lies in the application of it, and I am compelled to ask myself how I am to apply the priority of mind to my own detailed and perhaps trivial explorations.

I am concerned with chromosomes. Some people have come to look upon these microscopic whim-whams as determining (if one may speak of determination) the properties of heredity and development. Now if the chromosomes determine the development of the whole organism, of which the mind is one (albeit the most precious) aspect, then these scarcely animate particles of matter, the mutations of which obey elementary physical laws, can determine the difference between mind and no mind at all; and particularly, if I were to follow this argument, I should be led to a most disturbing conclusion, namely, that the sperm which will give rise to a man (and his mind) differs from one which will give rise to a female of the species (and her mind) merely by the absence of a piece of one chromosome, a speck of matter. To this end are we led through blindly following the sophistries of material dialecticism, which (as Mr. Marvin laments) are so prevalent to-day. This view needs only to be stated for its contradictory nature to become evident.

On the other hand, if mind or spirit or purpose determine both sex and loss of chromosome at the same time, everything will, I suppose, be clear and straightforward. I say, 'I suppose', since Plato and Aristotle were unfamiliar with this situation, and Epicurus in any event gives me the wrong answer. I now turn to Mr. Marvin in confidence that he will be able to tell me (with or without the help of Dr. Federn) how I may come to apprehend a deeper truth from the misleading images recorded by science. Then I may perhaps myself be able to rewrite the present theory of heredity with a proper appreciation of higher things.

C. D. DARLINGTON.

John Innes Horticultural Institution,
Mostyn Road, Merton Park,
London, S.W.19.
Nov. 13.

[1] NATURE, 146, 690 (1940).

RESEARCH ITEMS

Biological Control of Lantana

In *Indian Forest Records* (Entomology) (**6**, No. 3; 1940) C. F. C. Beeson and N. C. Chatterjee discuss the possibilities of the biological control of *Lantana aculeata.* The problem of destroying Lantana by means of insects is one of special interest to forest officers in India. It is concluded that no indigenous species of insects feeding on this shrub is sufficiently promising for this purpose, yet altogether 400 species of insects are known to visit Lantana in India. In the Dehra Dun district the biology of 54 species has been investigated. The regular breeders on the plant are prevented from increasing abundantly by wilt-like diseases and parasites. The most promising lines for the future seem to be (*a*) the introduction of the Lantana bug, *Teleonemia scrupulosa* and (*b*) eventually to explore the original home of Lantana in tropical America in search for additional insect enemies or diseases. The subject is one for the consideration of the Board of Forestry with the view of developing an all-India policy to be followed. In the meantime unauthorized importations of Lantana insects into India should be prohibited.

A New Genus of Fossil Sponges

A new genus (Protohyalostelia) of sponges discovered in lower Cambrian strata in South Australia has been described by Frederick Chapman in a paper recently read before the Royal Society of South Australia. All previous records of sponges in the Australian Cambrian have been confined to sporadic occurrences of anchoring spicules and separated sponge spicules. This new discovery is remarkable in that actual sponge bodies have been preserved with the spicular structure more or less in position. They are, therefore, the first of their kind to afford definite evidence of their taxonomic position among Lower Palæozoic sponges. In form they are cup-shaped, varying from vase-like to elongate, almost cylindrical bodies. The spicular structure shows that they belong to the Lyssakine group of the Hexactinellida. It is suggested that the present Cambrian genus, Protohyalostelia and other related ones, as Hyalostelia (Cambrian to Carboniferous) should be placed in a new family, the Hyalosteliidæ.

House-Sparrow in New Environment

In the fifties of last century the house-sparrow, *Passer domesticus*, was set free in the United States of America and since then it has settled and flourished in the entire continental United States except Alaska. Most of the original individuals were imported from England, some from Germany, and it is a matter of interest to inquire what changes, if any, have been induced by an environment which has enforced some changes in food and in predators, as well as changes in climate. Some years ago the writer obtained a series of skins of American house-sparrows from Dr. Outram Bangs, and found that the range of variation in colour of plumage did not exceed that shown by the sparrows in Great Britain, but David Lack has submitted certain characters to the test of measurement (*Condor*, **42**, 239; 1940). The characters chosen were length of bill from nostril to tip, depth of closed bill, and length of wing (standard measurement). American sparrows were found to have on the average rather larger bills and wings than English ones; but they are not larger than German specimens, so that it would be hazardous to say that any significant change had taken place. In America itself, however, analysis by region shows that the sparrows from southern California have larger bills, as regards length and depth, than those from other regions, and they are also larger than in German sparrows, so that some variation appears to be taking place in accordance with the trend observed elsewhere, that extremities, such as bills and legs, become longer in regions of warmer temperature.

Analysis of Winter Temperature

The *Monthly Weather Review* of the U.S. Weather Bureau of June 1940 (vol. 68, No. 6) contains a summary by C. J. Root of the winter temperatures recorded at one of the stations in America with the longest unbroken record (eighty years). The station is Marengo, Ill. The summary is made in such a way as to bring out most clearly the long-period trends, graphs being given of the five-year and ten-year averages for the winter (December–February) from 1856–57 to 1936–37. Both these graphs show a decline from initial warmth to a minimum for the period ending with the winter 1885–86, and then a recovery to more than the initial warmth. Thus the five-year mean for the period ending in February 1886 was only just above 18°F. and that for a similar period ending in February 1932 was more than 25° F. This winter mildness of recent decades is shown not to be due to a change in the site of the instruments; it is in agreement with the trend at many other places in America as well as in Europe.

Crustal Structure of the United States

Two papers presented at the Cincinnati meeting of the Eastern Section of the Seismological Society of America on May 31 and June 1, 1940 (*Earthquake Notes*, **12**, Nos. 1 and 2; September 1940), are important in that they suggest a different structure in the United States from that determined previously for certain other regions in the world. The first paper is by Henry F. Birkenhauer, *S.J.*, and concerns the Illinois Basin earthquake of November 23, 1939, with epicentre near Redbud, Illinois. The velocities of seismic waves determined from records from thirteen observatories were found to be $\overline{P}$ 5·9, $\overline{S}$ 3·3, P^* 6·6, S^* 3·9, P_n 7·3, and S_n 4·1, all km. per sec. To fit the seismogram readings the author suggests an upper layer 26 km. thick and an intermediate layer 12 km. thick above the Mohorovicic discontinuity. The second paper, by Edward J. Walter, concerns "Earthquake Travel-Times and Structure South of St. Louis". Six local earthquakes were studied, and the structure suggested consists of three layers above the substratum. From the top downwards the author suggests layers 5 km., 20 km. and 12 km. thick and velocities of P 6·03, 6·33, 7·19 and 7·73 km./sec. respectively, and of S 3·63, 3·74, 4·08 and 4·40 km./sec. respectively in these layers and the substratum. The improved or new teleseismic stations mentioned by N. H. Heck of the U.S. Coast and Geodetic Survey at the same meeting, namely, those at Burlington, Vt.; Pittsburgh, Pa.; Columbia, S.C.; Des Moines, Iowa; Logan, Utah; Reno, Nev.; and Ukiah, Cal., should prove exceedingly useful, along with stations already existing, in testing the above hypothesis.

Determination of the Depth of Glacial Deposit

A SERIES of seismic profiles has recently been run in the Riverside Section of the town of Weston by L. D. Leet and T. J. Smith, *S.J.* (*Earthquake Notes*, **12**, Nos. 1 and 2; September 1940). Using the seismic exploration unit belonging to the Humble Oil Company of Houston, Texas, the authors showed the average depth of glacial deposit in the area to be approximately 100 ft., increasing to 250 ft. in the pre-glacial valley of the Charles River near by.

A New Fine Oil

IN view of the difficulty which is now experienced in obtaining from the usual sources supplies of clock oil or Jouvain oil suitable for use as a lubricant for many precision and other instruments and for light machines, it is of special interest to learn that a new product has been introduced to take its place. This new lubricant, which is referred to as Clock Oil R.304, has been evolved by Messrs. Stafford Allen and Sons, Ltd., of Wharf Road, London, N.1, working in conjunction with the chemists of the Admiralty Research Laboratory, and has secured the approval of the latter. A sample which has been submitted for inspection shows a preparation possessing the physical and chemical properties requisite for the purposes indicated, while the fact that it has passed all the stringent tests required by the Admiralty Research Laboratory carries the assurance of its suitability for use with instruments under normal conditions of service. The makers offer to answer further inquiries as to the characteristics of the oil.

Softening Point of Glass

AT a meeting of the Society of Glass Technology held on November 20, J. T. Littleton presented a paper on the above subject. Two definitions of softening point are at present in use. According to Dr. Littleton, it is that temperature at which a fibre of glass, 9·25 in. long, of a diameter between 0·55 and 0·75 mm., suspended vertically in a furnace of specified characteristics, will elongate under its own weight at the rate of 1 mm. per minute. Under these conditions such a rate of extension takes place when the glass has a viscosity of $10^{7\cdot6}$ poises. The second definition is that agreed on by the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft, and is the maximum point reached on the complete thermal expansion curve of a glass. Again this point is dependent on the experimental conditions, and the apparatus employed has to be standardized before a definite viscosity value can be allocated to the point so determined. The two methods were then described and the results obtained by them compared. The fibre-extension method was claimed to give results precise to better than one degree, whereas the interferometer method is not so precise. The latter method is based on the measurement of a temperature at which an effect having no magnitude occurred, whereas the fibre-extension depends on measuring the temperature at which the magnitude of the effect has a definite value. Softening point determinations are a rapid and reliable means of ascertaining if any variation in the characteristics of a glass has occurred. The fibre-extension method has been in use at Corning Glass Works, U.S.A., for more than thirty years, and during the last few years about ten thousand measurements a year have been made.

Atmosphere of Venus

DR. R. WILDT makes an interesting suggestion as to the chemical constitution of the clouds which are observed on the disk of the planet Venus (*Astrophys. J.*, **92**, 247; 1940). The atmosphere of the planet is at present spectroscopically free from water vapour but rich in carbon dioxide, and is filled with white clouds the nature of which is still unknown. Dr. Wildt makes the assumption that the primordial atmosphere was one mainly of carbon dioxide, but containing small quantities of water vapour. A photochemical reaction between these constituents when they are illuminated by ultra-violet sunlight will produce formaldehyde, the oxygen so released being chemically absorbed by the surface layers. Moist formaldehyde gas rapidly polymerizes into a mixture of solid white polyoxymethylene hydrates $(CH_2O)_x.H_2O$, which, it is suggested, constitute the observed clouds. The vapour pressure of formaldehyde in equilibrium with the solid polymers is small, so that the ultra-violet electronic absorption bands of the gas will not be expected to appear, as Dr. Wildt indeed finds from his observation of the spectrum of the planet. The vapour pressure of the polymers themselves is of the right order at the temperature of the Venusian atmosphere to allow of the formation and dissolution of clouds by the processes of condensation and sublimation. An attractive feature of the theory is that its basic assumption as to the primordial constituents of the atmosphere accounts for the present lack of free oxygen on the planet.

Absorption of Light by Interstellar Matter

THE solutions of many problems of stellar distribution in our galaxy depend on the value assumed for the mean coefficient of absorption of light by interstellar matter. Many investigators have in fact used such a mean coefficient without making a critical examination of its validity for the purpose in hand. Doubt is now thrown on the legitimacy of this procedure by Stebbins, Huffer and Whitford (*Astrophys. J.*, **92**, 193; 1940). From their recent investigation of the colours of 1332 *B*-type stars near the galactic plane and out to 2,000 parsecs from the sun, they conclude that the effect of the interstellar material is too irregular to be represented by a mean coefficient of selective or of total absorption. Even when taken over such a limited region of the sky as one 10° square, the values of colour excess obtained for stars of the same spectra and apparent magnitude (that is, for stars at approximately the same distance) show such a large dispersion that the authors are forced to postulate the existence of small clouds of obscuration. No reasonable treatment of the data can make the star colours fit relations in which absorption is put proportional to distance. An attempt to remove from the data the effect of the more obvious clouds leads to a decrease in their mean coefficient of selective absorption from 0·17 mag. per kiloparsec to 0·12; but, as the authors point out, their exclusion of abnormally reddened stars is arbitrary and results in a coefficient the physical significance of which is scarcely less open to criticism than that of the original one.

EDUCATION OF WORKERS IN APPLIED PHYSICS*

By Dr. H. Lowery,

Principal of the South-West Essex Technical College, Walthamstow

In observing the rapid growth during recent years of large industrial research organizations which have for their declared object that of producing advances in industry and commerce, we are apt to be tempted to think that the relationship between science and industry is something peculiarly modern, whereas in point of fact it dates back to the dawn of communal life. Actually all that has happened is a quickening of the pace of what is but a natural interaction between the acquisition of new knowledge and its application to human needs. When once man had learnt some new fact by his trial-and-error methods, say in the handling of metals, he proceeded immediately to turn the discovery to his advantage, thus extending the range of application of his material and its general utility. Just so, the continued improvement of the products of modern industry and the evolution of new industries are due to the successful application of recently acquired ideas and the development of improved techniques and processes of manufacture. The interesting point to note, however, is that we no longer rely upon the crude method of trial and error, fruitful as this method was in the past; on the contrary, most industrial advances are the result of the deliberate application of the scientific method. The rapidity of the advances is due to the existence of a great co-operative effort between those who practise a given industry and those who endeavour to discover new facts, principles and practical possibilities. Discoveries are thus no longer left to chance, and though they cannot be made to order at least we can ensure that existing knowledge is put to the best possible use and the ground carefully cultivated by systematic observation and experiment so as to favour the growth of new knowledge.

That the relation between the acquisition of knowledge and its subsequent application to the satisfaction of human wants is perfectly natural in character and that the discoverer and the practical man are therefore on an equal footing has unfortunately too often been overlooked in the past, with the result that there has frequently arisen an attitude of superiority on the part of the discoverer towards the manual worker, followed by a curious superiority of attitude of the academic research worker towards the technologist or scientific worker who deliberately aims at applying knowledge in the fields of industry. Happily this type of snobbery is gradually being broken down, but where it still persists it is a constant source of irritation to the people concerned and leads to regrettable industrial inefficiency.

In view of the splendid successes already achieved by industrial research laboratories in developing old-established industries and inaugurating new ones, the recognition of the professional scientific worker as an essential part of the industrial organization seems assured. Hence arises the educational problem as to the best kind of training to enable him to play his part to the full in the new scheme of things. Not less important is the necessity for making the ordinary employee scientifically minded at least to the extent that he may be led to co-operate freely in the industrial changes dictated by scientific investigation. This in turn demands of the scientific worker personal qualities such as will enable him to strike a bond of friendship with the worker in the factory, thereby inspiring a spirit of co-operation helpful alike to present production and future developments.

It is important that all industrial workers should realize that the man of science has much of value to say not only on material matters but also on the many human problems that arise daily in the modern factory; the view that the man of science is a narrow specialist must be combated until it is entirely removed and confidence engendered so that his opinion and advice may be freely sought when difficulties arise either in the works or among the staff. Moreover, it is worth while pointing out that Governments can no more dispense with the aid of the scientific worker than can industrial undertakings.

The demands made by industry upon scientific workers are so diverse that it has long been found necessary for those workers whose interests are somewhat related to form themselves into groups for the pooling of knowledge, the interchange of ideas, and the discussion of problems arising from their employment in industry. In this way many learned societies and professional organizations have come into being. The latter have usually emphasized the personal relationships between the scientific worker and industry, and have quite naturally been concerned with determining the most appropriate form of training to enable their members to render effective aid to industry. For a variety of reasons (into which we need not enter here) professional organizations for engineers and chemists were established long before that for workers in applied physics; but in 1918 the Institute of Physics was founded with the object ". . . of the elevation of the profession of physicist and the advancement and diffusion of a knowledge of physics, pure and applied, and for this purpose especially: To promote the efficiency and usefulness of its members by setting up a high standard of professional and general education and knowledge, and by compelling the observance of strict rules of personal conduct as a condition of membership".

The foundation of the Institute came at a most opportune time, for the results of a period of unprecedented activity in physical research were beginning to find their practical applications, with consequent rapid expansion of industrial enterprise.

The Institute began by enrolling physicists of approved status and was thus able to form a panel of consultants which has been of invaluable assistance to industry. Lectures on "Physics in Industry", given by eminent industrial physicists, not only provided much-needed surveys of the achievements of physics in various industrial processes but also prepared the way for new advances by suggesting fresh lines of research in applied physics. The scope of the activities of the Institute was greatly widened by the formation of branches, the first of which began in Australia and India. In 1931 a local branch was formed in Manchester. This was quickly followed by a Midland Branch with its centre in Birmingham, and later (1936) by the London and Home Counties' Branch.

---

* Based on a paper read before the London and Home Counties' Branch of the Institute of Physics on October 26. (The views expressed here are not necessarily those of the Institute of Physics.)

By means of the local branches the Institute is able to provide for the 'continued education' of its members; up-to-date surveys of recent advances in pure and applied physics are given at the branch meetings by various specialists; conferences and exhibitions on the applications of physics are arranged, and facilities provided for social intercourse among the members, so furnishing the means for the exchange of ideas between workers from different industries.

It is perhaps natural that the standards for admission to full membership adopted by the Institute were based on those of the universities, for at the time of the inception of the Institute these were the only standards easily definable, namely, an honours degree in physics coupled with some post-graduate training. Subsequent experience derived mainly from observations on the employment of physicists in large industrial laboratories seems to show that other standards of assessment of the status of the physicist may now be applicable. For example, in view of the overlap of the work of the physicist into the fields of biology, chemistry and engineering, a training in 'general' scientific subjects is found by many organizations to provide the most suitable preparation for the young physicist, together with some later appropriate specialist technical training.

Opinions differ as to whether the young physicist should carry out post-graduate training in the university before entering industry, or whether he should go direct into the industrial laboratory, or even whether his degree training should not perhaps be modified by some preliminary contact with the works. If one may judge by the reports given by directors of industrial research at the Conference on the Training of Industrial Physicists held by the Institute in February 1936[1], it would appear that each industry has its own individual preferences on these points. Moreover, the position in the United States does not seem materially different in this respect[2]. Nevertheless, given a certain approved minimum training, all employers emphasize the importance of the possession of those personal qualities which will not only enable the research worker to work amicably with those in the factory but will also help him to express the results of laboratory investigations in such a way that they will be acceptable even to those whose long experience in industry has rendered them almost impervious to anything that breaks with tradition.

We may note that industry now employs large numbers of young people who proceed directly into the works at the end of their school careers, a fair proportion of whom develop into highly valued workers in applied physics. They attend part-time day or evening classes at their local technical college and ultimately obtain a degree or professional diploma and possibly even a research degree as well[3]. It is gratifying that increasing numbers of employers are willing to co-operate with the local colleges by releasing their junior employees for several half days' college work per week, and there seems to be no reason why this practice, at least in normal times, should not become universal. The benefits to the student are immeasurable and in the end it is unlikely that the firm would be the loser; indeed, some large firms testify highly to the value of the product of such a 'sandwich' system[4].

The technique of teaching has now reached such a point that we can almost 'teach anyone anything'; certainly we have little to learn regarding the art of getting people through examinations, and yet this does not guarantee that those who are coached successfully even to the taking of the highest academical honours shall be of more than average value in industry. Indeed, one physicist[5] has seriously asked whether "we are not actually harming some of our best men; lessening their vitality, delight in their work, and common sense by too efficient a system of training them to answer the questions we set in their examination papers".

When we come to the consideration of the content of the physics course we are again faced with the problem that individual firms often expect their own special requirements to be catered for. Despite the fact that it is impossible to produce a course of training that will meet every demand, there are certain general matters that any well-balanced course should provide, namely, a readily applicable mathematical equipment; some practical acquaintance with workshop processes such as turning and glass-blowing; the uses of industrial instruments such as the spectrometer, polarimeter, microscope, camera, thermionic valve and oscillograph; some acquaintance with the general principles of instrumental design; a knowledge of how and where to find technical information; and a reasonable command of the English language, both spoken and written. Complaints have often been made (quite justifiably) by employers that such general things as these have often been neglected in favour of an overdose of atomic physics.

War-time is perhaps not the best time for making changes; but it is pleasing to note that industry, the universities, technical colleges and the professional organizations are alive to the problems involved in the training of young recruits for industry, and we may reasonably hope to see very substantial and beneficial modifications in the training of all scientific workers when the time is ripe. At the outbreak of war we were on the eve of great developments in technical education heralded by the establishment of a new type of college with ample provision for social and cultural interests in addition to the requirements of vocation. It is to be hoped that these developments are merely postponed, for there can be no doubt that they are calculated not only to ensure an adequate flow of enlightened technologists into industry but also to produce a supply of scientifically and socially minded men fit to be leaders in the great period of world reconstruction.

---

[1] Crowther, J. A., "The Training of Industrial Physicists" (*J. Sci. Inst.*, **13**, 141; 1936).

[2] Hardy, A. C., "The Physicist in Industry" (*Amer. J. Phys.*, October 1940).

[3] Owen, D., "The Teaching of Physics in Technical Institutions", Reports on Progress in Physics, **6**, 431 (Physical Society, 1939).

[4] Fleming and Pearce, "Research in Industry", p. 168 (1922).

[5] Bragg, W. L., "Some Views on the Teaching of Science" (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, **72**, 119; 1927).

APPLIED BIOLOGY IN WAR-TIME

A WELL-ATTENDED and representative meeting of the Association of Applied Biologists was held at Harpenden on December 6 under the presidency of Mr. C. T. Gimingham to discuss the function of applied biology in war-time. In the opening paper, Sir John Russell dealt with the three general groups of problems to which applied biology can usefully contribute: maintenance of public health during the War; protection of food and other materials, for example, wood, flax, etc., both in the field and in store against deterioration by biological agents; and increase in the amount of food supplies.

While the maintenance of public health is primarily the business of the medical authorities, applied biologists can render valuable assistance in the adequate cleansing of shelters and of the persons and property of evacuated people. Much of the difficulty of finding accommodation in reception areas is due to the fear that insects and diseases may be brought from the cities into clean country homes, as actually happened in the first evacuation. It is, however, chiefly in connexion with food supplies that applied biologists are usually concerned, especially with food protection. The average dietary in Great Britain is both varied and attractive, but it cannot be maintained in war-time; a much simpler diet is necessary involving less meat, butter, eggs and sugar, but more potatoes, vegetables and bread. Of this new dietary we can produce far more than the 40 per cent of pre-war days: already the figure is well above this and will, it is hoped, be still higher. But the new programme necessitates the conversion of grass land to arable, and various members of the grass land population need controlling. Wireworms do much damage to wheat and other cereals. In the War of 1914–18 no adequate control measures were found, and unfortunately only a moderate amount of investigation was made in the peace period, so that we are still in much the same position as in 1918. Two fungi injurious to wheat have come into prominence since the War of 1914–18: *Ophiobolus graminis* and *Cercosporella herpotrichoides*: the former is harmful on light rather alkaline soils, and the latter is encouraged by the nitrogenous manuring now being enjoined on farmers. The potato crop is liable to a considerable number of pests and diseases, but some of the worst, for example Phytophthora blight and wart disease, can be dealt with. The virus diseases are now the most troublesome; fortunately they are now being vigorously studied. In the meantime they can be avoided only by the use of virus-free seed, but this is not always convenient.

For animals it is necessary to provide more protein equivalent, as the quantity produced on the farm tends to be reduced by ploughing out. Beans would furnish useful supplies, but are liable to attack by aphids. Marrow stem kale is an excellent transformer of simple and easily obtainable nitrogen compounds into protein equivalent, but it may suffer badly from the turnip flea beetle. Fuller control measures are desirable.

Considerable help has already been rendered, however, by applied biologists in saving crops and also the finished products milk and meat. Cleaner milk is now realizable in practice, and bacteriological control is understood and appreciated by many farmers; while valuable service has been rendered in regard to the control of the sheep blowfly and the tick *Ixodes ricinus*, which causes louping in sheep. The storage of food presents numerous problems now happily far better understood than in the War of 1914–18.

The investigation of war-time problems will necessitate numerous studies and surveys which, it it hoped, will be so planned that the results can be subjected to statistical analyses. Little more trouble is involved, and the value of the work is greatly enhanced.

Two food production activities come within the scope of applied biologists. Honey production is capable of much expansion in Great Britain: already about one million pounds' worth is produced annually, but bees render even greater service than this in the pollination of fruit trees and certain other plants. The other problem is not so well advanced. During the War of 1914–18 the Germans were said to be using a yeast for the production of protein and fat for human consumption. It is hoped we shall not need to do this; but it would be of the greatest value if some process could be worked out for synthesizing protein for animals. Suitable nitrogen compounds are available, but the substrate presents difficulties; various wastes might be used, but the ideal source of carbohydrate would be straw, which is available in particularly large quantities on most farms.

These are the main problems: the question is how best to organize the activities of applied biologists so as to ensure finding some solution now, and continuing the work after the present war is over.

In the discussion Prof. J. W. Munro, Mr. J. C. F. Fryer and others emphasized the fact that the war-time biological problems of to-day include many of those of the War of 1914–18, and if we had continued work on them during the past twenty years with the same impetus we should now have been in a much happier position. There was also the old difficulty of ensuring that existing knowledge should be fully applied in practice. Mr. Fryer instanced leather jackets, which had damaged thousands of acres of crops, and the white cabbage butterfly, which last year caused much loss, both of which could have been controlled. It was, however, more difficult to forecast outbreaks in Great Britain than on a Continental area. Mr. Findlay spoke of the serious wastage of sandbags because certain known precautions had not been taken.

It was strongly urged by Drs. Blackman, Ainsworth, Barnes and others that biological experts are not being fully drawn upon at the present time, and on the motion of Dr. Goodey and Mr. Fox-Wilson the Council of the Association of Applied Biologists was asked to bring to the notice of the appropriate bodies the pressing problems which exist to-day in applied biology and to discuss with them the means of utilizing to the best advantage the services of applied biologists.

COSTS OF ELECTRICAL HEATING

IN *Electrical Industries* of November, Mr. F. D. Parker criticizes methods of measuring the running costs of electricity when used for heating and cooking installations. If the estimates given are too high, the company loses a valuable load; and if too low, there is often dissatisfaction and complaints. In particular, the estimating of 'space heating' loads is especially difficult owing to the fact that so much depends on many undeterminable factors.

Weather conditions are very closely related to energy consumption in much the same way as the amount of hot water used determines electric water-heating consumption. The main difficulty is that whereas the latter can in some measure be computed, the former is always conjectural. It has also to be remembered that running costs of heating installations in the south of England cannot be considered representative of those in the north, where more severe weather conditions are experienced. This emphasizes that data obtained from other installations, when not in the same locality, must be employed with caution.

Further factors influencing space-heating consumption are: type of building, position, heat-loss characteristics, hours of use, time of use and thermostat setting. The provision of revolving doors, springs on doors to exclude draughts and the system of ventilation adopted, if any, all appreciably affect operation costs. It follows that the estimating of space-heating consumption is a much easier matter when dealing with existing buildings than from plans of buildings to be erected. In the latter case, allowance has necessarily to be made for the drying out of buildings during the first year.

In the domestic sphere, estimating space-heating consumption is very conjectural, as the element of careless usage is always present. This, coupled with variations in consumers' habits and ideas as to the amount of heat required, usually prevent space-heating consumption of one consumer being considered representative of other consumers even of identical characteristics. Apart from all-electric houses, etc., the majority of domestic space-heating consumers may be considered intermittent users. No difficulty therefore is likely to arise if consumers are advised of the consumption of the apparatus on various 'heats'—which should be done when appliances are purchased, especially from supply authorities.

With new all-electric consumers the position is somewhat different. Apart from thermostatic control and continuous heating, running costs are proportional to hours of usage, which often cannot be determined. If consumers therefore require some idea of annual space-heating costs, then the only arrangement is to obtain from them details as to probable usage and build up estimates accordingly, assuming $\frac{1}{2}$–$\frac{2}{3}$ of the total loading of the heating apparatus is in use per hour. In regard to the heating of corridors, halls, etc., much depends on the type of apparatus installed and the method of control. It is advisable to eliminate hand control as much as possible, as apparatus employed for such purposes is apt to be neglected.

The calculation of operation costs on a heat loss basis for direct heating, assuming, for example, minimum outside temperatures of, say, 25–30° F., to maintain 60° F. internally, to obtain the required loading, and then assume average winter temperatures of, say, 40–44° F. and arrive at the consumption accordingly, relatively to the hours of usage, heating-up times, etc., should provide reasonable estimates. The trouble is that theoretical heat-loss calculations of buildings seldom hold good in practice, owing to faulty construction, badly fitting windows and doors. Weather conditions such as effects of sun and wind should be taken into account.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

INSPECTOR (WOMAN) OF SCHOOLS, and an ADMINISTRATIVE ASSISTANT (MAN)—The Director of Education, Education Offices, Leeds 1 (December 31).

PRINCIPAL OF THE ROYAL TECHNICAL COLLEGE, Salford—The Director of Education, Education Office, Chapel Street, Salford 3, Lancs. (December 31).

GRADUATE ASSISTANT TEACHER FOR MECHANICAL ENGINEERING SUBJECTS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (January 6).

ASSISTANT MASTER OR MISTRESS FOR SCIENCE (mainly Mechanics, Heat and Chemistry)—The Acting Principal, Technical Institute, Sheerness.

ASSISTANT ENGINEER FOR THE DRAINAGE AND IRRIGATION DEPARTMENT, Malaya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9316).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Museum (Natural History). Economic Leaflets, No. 6: Plaster Beetles. Pp. 4. (London: British Museum (Natural History).) 1*d*. [1811

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 23: An Analysis of the Influence of Weather upon a Migratory Movement of Birds. By Prof. James Ritchie. Pp. 299–321. 2*s*. Vol. 60, Part 3, No. 24: Early Glacial Remains of Reindeer from the Glasgow District. By Dr. M. Macgregor and Prof. James Ritchie. Pp. 322–332. 1*s*. 3*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [2011

Lecture on "The Mechanism of Enzyme Action". By Dr. J. H. Quastel. Pp. 28. (London: Institute of Chemistry.) [2111

Other Countries

Scientific Publications of the Cleveland Society of Natural History. Vol. 8, No. 3: On One of the Least Known of the Cleveland Shale Arthrodira. By David H. Dunkle and Peter A. Bungart. Pp. 29–48 + plates 4–5. (Cleveland, Ohio: Cleveland Society of Natural History.) [1511

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 3: Studies on some Characteristics of Indian Coking Coals. By Dr. R. K. Dutta Roy. Pp. 28. (Calcutta: Geological Survey of India.) 7 annas; 8*d*. [1811

Field Museum of Natural History. Botanical Series, Vol. 22, No. 4: Studies of American Plants, I. By Paul C. Standley and Julian A. Steyermark. (Publication 480.) Pp. 219–322. (Chicago: Field Museum of Natural History.) 75 cents. [1911

Contributions to Embryology. Vol. 28, Nos. 170 to 178. (Publication No. 518.) Pp. iii + 451 + 34 plates. (Washington, D.C.: Carnegie Institution of Washington.) [2011

U.S. Office of Education: Federal Security Agency. Bulletin, 1938, No. 14: Teaching Conservation in Elementary Schools. By Effie G. Bathurst. Pp. v + 125. (Washington, D.C.: Government Printing Office.) 20 cents. [2011

Catalogues

Prokayvit and Prokayvit Oral. Pp. 2. (London: The British Drug Houses, Ltd.)

The Hilger Photometric Colour Comparator (an "Abridged Spectrophotometer") with a description of the Hilger Photometric Amplifier. (SB. 289.) Pp. 8. (London: Adam Hilger, Ltd.)

Various Books, also a Complete Set of Gould's Birds. (Catalogue No. 652.) Pp. 68. (London: Francis Edwards, Ltd.)

Early Botany and Herbals, Old Medicine and Science. (Catalogue 60.) Pp. 54. (London: E. P. Goldschmidt and Co., Ltd.)

Diary for 1941. Pp. 16 + 32 maps + Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, DECEMBER 28, 1940 No. 3713

CULTURAL SIGNIFICANCE OF SCIENTIFIC METHOD

FEW things have contributed more to consolidate the unity of the nation and to fortify its resolve to persevere until victory is achieved than the realization that the present struggle is between two fundamentally opposed ways of living—between an order in which the individual is crushed and in bondage to a monstrous conception of the State, and an order in which personality is respected, the great traditions of Western civilization are cherished and the human spirit is free to enrich that heritage by further creative work in art, in literature, in science and other spheres of culture and thought.

Although democracy and totalitarianism are fundamentally opposed ideals, we should not make the mistake of assuming that the democracies have nothing to learn from the totalitarian regime. On the contrary, it is of the utmost importance that there should be a clear understanding of the causes which led to the rejection of democracy, and the emergence of the totalitarian States during the two decades following a war which was to have made the world safe for democracy. Unless we are willing in these fields also to learn from our opponents and to seek to eradicate the weaknesses of democracy as they are brought to light, we may once again experience the frustration which followed the War of 1914–18.

"The serious threat to our democracy is not the existence of foreign totalitarian states. It is the existence within our own personal attitudes and within our own institutions of conditions similar to those which have given a victory to external authority, discipline, uniformity and dependence upon the Leader in foreign countries." This warning of John Dewey in his recent study of "Freedom and Culture" (London : Geo. Allen and Unwin, Ltd., 1940. 7*s.* 6*d.*) is the more timely when there are already appearing articles even in the technical Press attributing our economic troubles to State interference with private competitive effort for gain, and advocating an immediate return to untrammelled *laissez faire*.

Whatever may be the nature of the social and world order after the War, it is certain that a return to the position of August 1939 with a minimum of disturbance is both illusory and dangerous. To desire no nobler prospect than a perpetuation of the disparities and injustices, the inertia and complacency of the period 1918–39 is a Maginot complex in the social realm, and treason to the spirit which the nation has displayed in the last nine strenuous months. A hide-bound persistence in methods and doctrines which were sound enough fifty or a hundred years ago may easily prove as costly in the financial, economic and social field as in the field of actual warfare. It might not lose the War ; it would almost certainly once again lose the peace.

A foremost need is an unprejudiced review of conditions as they are now and as they are likely to be after peace has been won, with an open and unprejudiced mind, ready to accept any changes which are shown to be necessary, however unpalatable, and to abandon any preconceptions, however deeply cherished, which have become unpalatable. Even this, however, is not enough. If we are to build an enduring order we must go even deeper. We must establish right relations between democratic institutions and human relations, with all that is understood by culture in the truest and widest sense of the word.

Democracy, as Sir Richard Livingstone has reminded us, like patriotism, is not enough. It is indeed a way of life and it affords men the best opportunity of leading the good life; but it is no guarantee that they will lead it. We have yet to realize that democracy is a way of personal life and one that provides a moral standard for personal conduct. Unless we can find that moral power, both the value and the very existence of democracy are in peril.

It is well that there should be no mistake as to the tremendous moral or even religious challenge thrown down to democracy at the present time. That internal challenge must be met if the external threat of the totalitarian States is to be overcome, and in his study of freedom and culture Prof. Dewey leaves no room for complacency, for all his confidence as to the ultimate issue. That will be assured so long as we face our problems in detail as they arise, with all the resources provided by collective intelligence in co-operation.

This question of the relation of freedom and democracy to culture involves not merely spiritual and moral issues but also those of science. As Prof. Dewey points out with respect to means for understanding social events, we are still living in the pre-scientific epoch, although the events to be understood are the consequences of the application of scientific knowledge to a degree unprecedented in history. It is this that gives such significance to Mannheim's recent attempt to develop a theory of planning for freedom and the technique of social control. No democracy has ever made complete or adequate use of scientific method in deciding upon its policies, although freedom of inquiry, toleration of adverse views, freedom of communication, and the distribution of what is discovered to every individual as the ultimate intellectual consumer, are involved in the democratic as in the scientific method.

Prof. Dewey's reminder of the potential alliance between scientific and democratic method is indeed timely, and not irrelevant to the organization of our war effort as indicated in a recent leading article (see NATURE, Oct. 12, p. 469). When democracy openly recognizes the existence of problems and the need for probing them as problems as its glory, political groups which refuse to admit incompatible or unpalatable opinions will be relegated to the obscurity which is already the fate of such groups in science.

Prof. Dewey has more to say about the interaction of science and society to-day and its relation to the future of democracy. One of the most stimulating chapters of his book is that in which he discusses the relation of science and free culture. We can no longer assume that the assured advance of science will lead to free institutions by dispelling ignorance and superstition. Some of the new powers with which science has endowed mankind, such as the radio and the Press, have proved potent tools of oppression and servitude. The question is raised whether science, like propaganda, can shape ends.

Prof. Dewey gives an admirable survey of the different points of view from which are approached the questions of the extent to which the shaping of science, and the determination of the direction of its advance, are determined by the social environment, and the social responsibilities of the scientific worker. This leads him not merely to raise the question whether a democratic society can exist without regulation, exercised by a public authority on behalf of social unity, of scientific pursuits, but also whether it is possible for the scientific attitude to become such a weighty and widespread constituent of culture as to shape human desires and purposes. This latter question involves the direct issue of the kind of culture in which scientific method and scientific conclusions are integrally incorporated.

It may be argued that one of the reasons why men have been willing to accept conclusions derived from science in place of older ideas has been their serviceability in some aspect of culture or industry. On this ground we might well hold that the kind of serviceability which is capable of generating the highest esteem for science is serviceability for social welfare. The development of economic and agricultural policy in post-War Europe to secure the maximum utilization of scientific knowledge of nutrition might be an important factor of this type in one special field.

The influence of science upon both means and ends is not exercised directly upon individuals but indirectly through incorporation within culture. Moreover, science is not simply a body of conclusions; even more important from a cultural point of view, science is an attitude of mind which resolutely employs certain methods of observation, reflection and test. Scientific inquiry indeed has a morale of its own, including willingness to hold belief in suspense; ability to doubt until evidence is obtained; willingness to proceed on evidence rather than on a personal preference; ability to hold ideas in solution and use them as hypotheses to be tested instead of as dogmas to be asserted; and the enjoyment of new fields for inquiry and of new problems.

As Prof. Dewey points out, each of these traits is contrary to some embedded impulse, and accordingly the mere existence of the scientific attitude and spirit is evidence that science has created a new morale—equivalent to the creation of new desires and new ends—and is capable of developing a distinctive type of disposition and purpose. This service of science may far outweigh its serviceability in the social field. The development of a scientific outlook is of fundamental importance for the preservation of democracy, and the transformation of educational content and method to encourage that development and not the mere inculcation of scientific facts is one of the most pressing problems in education to-day. The fate of democracy is bound up with the spread of the scientific attitude. More important even than the contribution of science to the solution of immediate and practical problems, the scientific attitude is the sole guarantee against wholesale misleading by propaganda. It is the only assurance of the possibility of a public opinion intelligent enough to meet present social conditions.

The democratic extension of the scientific morale in this way until it is part of the usual equipment of the ordinary individual involves moral problems also. The scientific worker must acknowledge his moral responsibility for wider communication of the results of his work to others besides those engaged in specialized research. The need, however, is not for scientific men to become crusaders in special practical causes. It is recognition by scientific workers of their social responsibility for contagious diffusion of the scientific attitude.

That task will not be achieved without abandoning once and for all the belief that science is set apart from all other social interests as if it possessed a peculiar holiness. Without sacrificing professional standards, we must find means of securing that the influence of science and respect for its followers are based, not on a sense of mystery or something apart, but on firm understanding of its outlook and ways of working. Much more than the mere dissemination of the facts ascertained in different branches such as physics, chemistry, biology, geology and the like is required.

Science, through the physical consequences of its technical applications, is determining the relations of human beings, whether individually or in groups, one with another. If it is incapable of developing moral techniques which will also determine these relations, the rift in modern culture may involve the doom of democracy and all the values of civilization. Whether science is capable of influencing the formation of ends for which men strive, or whether it is limited to increasing their power of realizing aims which are formed independently of science, depends on the intrinsic moral potentiality of science. A culture which permits science to destroy traditional values but distrusts its power to create new ones, is a culture which, as Dewey remarks, is destroying itself.

The contribution which science can make to the war effort and to the reconstruction which must follow the War in the physical and material realm is gradually becoming more widely appreciated, even if we have far to travel before its full measure is realized. The chief merit of such publications as "Science in War" (see Nature, July 27, p. 112) is indeed the way in which they direct attention to such possibilities and stimulate thought in that field. The contribution which science can make in the cultural field is equally important but far less widely appreciated even among scientific workers themselves. Prof. Dewey's little study is accordingly the more timely and welcome. If scientific workers are stirred by it to think more deeply upon such issues and to concern themselves with this question of diffusing the scientific outlook, they may well make an all-important contribution both to winning the War and building the peace to follow.

Science requires a tradition of freedom of thought, investigation and teaching such as is inherent in a democratic system, if it is to flourish and exert its creative powers; in the same way, democracy has no less need of the spirit and work of science. While cherishing individual freedom and initiative, the whole democratic system must be rigorously scrutinized; we must approach it in an unprejudiced scientific manner, showing ourselves willing to discard whatever is outworn or has served its purpose, ready to learn even from its opponents and to take pains to incorporate new methods or new ideas while safeguarding those to which its own vitality is due. The fundamental thinking which is a prelude to a closer alliance between democracy and science, as a condition of a new and richer world order of freedom and plenitude, must be undertaken now. It may well issue in an era of creative thought and power in science no less than in those other branches of culture of which democracy is alike nurse and champion.

WEATHER AND WEATHER PROPHETS

(1) Weather Prediction
By Major R. M. Lester. Pp. 256. (London: Hutchinson's Scientific and Technical Publications, 1940.) 10*s.* 6*d.* net.

(2) Forecasting Weather
By Sir Napier Shaw. Third edition, with a Supplementary Note on Sixteen Years' Progress in Forecasting Weather, by R. G. K. Lempfert. Pp. xliii + 644. (London: Constable and Co., Ltd., 1940.) 42*s.* net.

THESE two books deal essentially with the same problem, that of forecasting to-morrow's weather, but they will appeal to different classes of readers. According to the publisher's note on the cover, Major Lester's book combines the functions of supplying the serious student of meteorology with an introduction to the deeper study of the subject and of supplying the amateur forecaster with an infallible guide. Some experience of trying to forecast to-morrow's weather has, however, convinced the present reviewer that no infallible guide to forecasting can be provided, either for the professional or the amateur meteorologist. Sir Napier Shaw has produced a third edition of his "Forecasting Weather", which appears to be intended for the scientific student of the subject. It is, perhaps, not unfair to say that while Major Lester has described the observed phenomena and their associations, Sir Napier Shaw has endeavoured to describe and to explain the phenomena in which he is interested.

(1) Major Lester's book is intended for the general reader who takes an intelligent interest in the weather, without having any specialized scientific training. It describes the national and international organizations in meteorology, the instruments and methods used at the observing stations, the codes used for reporting to the central office, the representation of the observations on synoptic charts, together with graphical methods for representing local observations, and comparing them with the conditions over a wide area. All stages up to the drawing of the synoptic chart are described clearly, but the reader does not gain from this book a clear conception of the use of the synoptic chart for the specific purpose of forecasting to-morrow's weather. Much information is given on the occurrence of certain types of weather; but it is doubtful whether the average reader will be able to absorb this information without some connecting threads of explanation. There are some very attractive cloud photographs, with very clear descriptions of the weather conditions in which such clouds occur. A chapter headed "Weather Forecasting" is, surprisingly, devoted to long-period weather forecasting, mainly by the use of cycles, and to weather maxims, from neither of which is the author able to draw much comfort. Later chapters survey the climates of the world and the variations of climate since the last Ice Age, and a final chapter is devoted to weather in war-time, with special reference to air-raid weather. The march of events since this book was written has modified some of our ideas on the subject of weather in war-time.

Anyone who reads through Major Lester's book will acquire a considerable knowledge of the facts which have been accumulated concerning the weather, but he will also unfortunately acquire some rather questionable ideas. When the author states "it is now believed that the secrets of the weather lie above the 20-mile limit", he deviates widely from the accepted opinion of meteorologists. He mentions the close correlation between the levels of Victoria Nyanza and the sunspot numbers, shown by Brooks to be very close over a little more than one sunspot cycle, without adding that the correlation disappeared almost completely in subsequent cycles. Major Lester quotes from an eminent meteorologist the statement "we are now in a period of decreasing solar radiation"—a statement which it is possible neither to prove nor to disprove. We are told that below 72,000 ft. will be found only a small fraction of the ozone in the atmosphere, whereas Dobson's observations indicate that, at least in middle and high altitudes, about one half of the ozone is below the limit stated. On p. 145, Major Lester states "Soviet Scientists have found how to make and disperse fog", giving an air of certainty to an achievement which is extremely doubtful. The statements to which objections are here raised take up relatively little space in the book, but they leave the impression that the vigorous use of a blue pencil would have improved Major Lester's book considerably.

(2) Sir Napier Shaw, in producing the third edition of his well-known book, "Forecasting Weather", has reproduced the second edition unrevised, asking his friend and former colleague, Mr. R. G. K. Lempfert, to write six short chapters on the progress in weather forecasting since the appearance of the second edition. As the second edition was published in 1923, the bulk of this edition may be said to represent the meteorological point of view of 1923. Meteorology has made some progress since 1923, and it would have been an

ve that progress incorporated in of the text, and not in chapters d. But the point of view of 1923 a special interest to-day. It centres of weather, rather than upon the s of the individual weather chart. It beginnings of the development of the f the atmosphere, and leaves the reader wish that Sir Napier had devoted more o the explanation of the physical processes ather. The too short chapter dealing with topic explicitly is a leisurely introduction to functions of water vapour in the atmosphere.

It is not possible to summarize here the thirty-wo chapters of this book. It does not pretend to be a systematic discussion of the physics of the atmosphere; but it covers a very wide field, so much so that essential information which we should hope to find is frequently omitted. Thus, although some sixteen pages are devoted to the discussion of barometric gradient and wind force, and the "gradient-wind" equation is given, the reader is not able to gather from this book why one solution of this quadratic equation is adopted, while the other is rejected as meaningless. On p. 241 we find the statement: "By instability in the atmosphere I mean a condition of affairs where a lighter layer is found with a heavier layer above it, so that the lighter layer breaks through the layer above and thereby causes an upward current that is violent until stable equilibrium is reached". This definition does not take account of the compressibility of the atmosphere, in consequence of which the condition for instability is, not that the density should increase with height, but that the temperature should not decrease with height at a rate exceeding a critical value of 1° C. per 100 metres. The correct definition is used in Chapter xxx. Density increasing with height requires that temperature should increase with height at a rate exceeding 3½ times the critical value. The present reviewer cannot recall having seen a single observation of so great a lapse-rate in the free air. Sir Napier's discussion of hail gives some very interesting facts relating to the breaking up of rain drops, but we should have been glad to have the author's views on the physical causes of the structure of a hailstone, which consists of alternate coatings of clear and white ice. Sir Napier defines fog as a cloud on the ground, as also does Major Lester, and the reviewer questions the value of this definition, in view of the fact that the dynamical conditions necessary for the formation of fog and cloud are usually widely different.

The author intersperses some very pertinent facts and figures. Thus, on p. 322 he illustrates a depression, the formation of which required the removal elsewhere of 190,000,000,000 tons of air. This very illuminating figure appears to the present reviewer to afford the appropriate answer to the question so frequently asked by one's friends —"When shall we be able to control the weather"? —the answer being "When we are able to stop a mass of air of 190,000,000,000 tons from going on its own way".

There are chapters on squall lines, sea fogs, warm water fogs and thunderstorms, and a summary of the work of Shaw and Lempfert on the life-history of surface air-currents. If this chapter will only stimulate the young meteorologist to read the original memoir thus summarized, it will have served a most useful purpose. That memoir contains many fruitful ideas which have not received due attention, and others which have been ascribed to other authors. The chapter on gales and gale-warnings contains summaries of the frequencies of winds of gale force and over, with a particularly interesting list of those gales during 1908 for which no warning was issued. We should like to see more frequent detailed discussions of these forecast failures, since the first step in learning to forecast the weather of to-morrow should be explaining the weather of yesterday.

There are chapters on forecasting for aviation, coal-mining, and agriculture. In dealing with the subject of forecasting for agriculturists, Sir Napier summarizes facts concerning the distribution of temperature in hilly country which should be, but are not, familiar to every agriculturist.

The space in which Mr. Lempfert summarizes the advances made since 1923 is insufficient to do justice to those advances. He contrives, however, to give the reader a conception of the growth of ideas on the structure of the depression, as well as of the changes of procedure in forecasting and reporting. Synoptic developments are illustrated by the Daily Weather Reports for May 1, 1939, and since Mr. Lempfert has used the chart issued at Bergen on the same day to illustrate the occluded stage of a depression, we are enabled to compare charts issued by London and Bergen based on exactly the same information. The differences shown in the fronts drawn in the two services serve to show how far from being impersonal is the drawing of fronts on a chart. The utilization of upper air data in the daily work of forecasting is illustrated by the use of a tephigram, which is the form of temperature-entropy diagram used in the British meteorological service. The tephigram was first devised by Sir Napier Shaw, and has become the standard form of upper air diagram in the British service. In his last chapter, Mr. Lempfert discusses the problem of forecasting for long periods, but holds out no immediate prospect of a solution of the problem for the British Isles.

Much of the progress which meteorology has

made during the last thirty years has owed its origin to the stimulus which Sir Napier Shaw brought to the subject, with an interest which he himself describes as that of the experimental physicist, in marked contrast with the essentially statistical point of view of most of his predecessors. Indeed, his attitude is so essentially experimental, that at times he tends to shun
algebra. Algebra has its uses, a
essential in any science which aspi
But, however much one may wish
chosen to model parts of his book in
it is, and will long remain, a book
and reading. D

PLACE-NAMES OF NOTTINGHAMSHIRE

The Place-Names of Nottinghamshire
By J. E. B. Gover; Allen Mawer and F. M. Stenton. (English Place-Name Society, Vol. 17.) Pp. xlii + 348. (Cambridge: At the University Press, 1940.) 21*s*. net.

IN the study of place-names, as in archæology, the interest of the early history of the county of Nottingham centres in the valley of the Trent. The one place-name which is recorded earlier than the ninth century, Tiouulfingacaestir, is identified with the Roman station of Segelocum at the point where the river was crossed by the main road from Lincoln to Doncaster; and the rock of Nottingham, which was of military importance throughout the period of the Danish War, overlooks the junction of the Leen and the Trent at the southern end of Sherwood Forest. The names of these rivers themselves, as so frequently in Britain, are relics of British settlement, and the Angles, using the rivers as their highway to Derbyshire and Staffordshire, established themselves here and there on either bank.

On the whole, however, the editors of this latest issue of the valuable surveys of English place-names point out, few place-names of an ancient type occur within the county. This indeed is not surprising in the Forest area, and the ancient word *beosuc* which occurs in Bestwood and probably in Bescar, is among the most definite among the pieces of evidence which point to an early penetration of the Forest by the English settlers in the Trent valley. Clumber and the river-names Clun, now Poulter, and Mann show that at least a small number of Britons remained in the Forest. The name Nottingham, the ham of the people of Snot, a personal name which appears again in the adjacent Sneinton in the form Snotengaham, is identified by Asser with the British *Tiggnocobauc* in reference to the ancient cave dwellings in the red sandstone hill at Nottingham; but the editors regard this as an invented Welsh name to suit the site.

The special interest of the place-names of Nottinghamshire lies in the fact that in the ninth century this region of eastern Mercia was divided among the members of a great Danish army. the editors point out, Nottinghamshire is not o of the counties in which the results of Danis colonization appear most clearly on the modern map. The familiar mark of Danish occupation in the termination *by* appears much less frequently than in a number of other counties, and indeed there are twenty-one names only with this identification mark, as against 260 in the county of Lincoln. Closer investigation, however, brings out the fact that the series of Scandinavian village names is longer than that of any district, outside Yorkshire, which has as yet come under the observation of the survey. Widely distributed Danish personal names, compounded with *Thorpe*, such combinations as *eik-hringr* (oak-ring; eakking), *Hrafner* or *Hrafner skialf* (the raven's shelf; Ranskill), Leake in early forms suggesting derivation from Lœkr "stream", with a number of others widely distributed, indicate the extent of Danish settlement within the county. The evidence is particularly strong in the western districts where that of Anglian settlement is weakest.

Yet there is evidence, in the modification of an earlier English name by its adoption by Scandinavian usage (Screveton; sherif's village which should have become normally Shrewton or some similar form), and in hybrid names, for example, by composition of the English *tun* with a Scandinavian personal name (Aslockton, Clipiton, Rolleston, etc.), that settlement had taken place in country well covered by English settlement before invasion began, and that these names indicate villages which became the property of a Danish owner, the English peasantry remaining for the most part unevicted.

On historical evidence it may be presumed that the population was predominnatly Danish, but the occurrence of the place-name Normanton, of which there are five examples in the county, implies settlement of the Norwegians, who predominated beyond the Humber.

An interesting light is thrown on social and funerary custom by that of Granehou among minor names (Grane's *haugr* or Grane's mound)

advantage to ha ıg parcels of land in the east
the main body . It was close by Granby and
added at the en)e connected, suggesting that the
is not without ı mound of the man who lived at
upon types nich the name ends in *by*.
idiosyncrasie which has been expended in the edit-
gives the
physics o
with th
space
of w
this
th

ing of this volume it is unnecessary to speak. In its method and arrangement, it follows the plan of the recent volumes of the survey, except that in this instance the editors have been able to rely in greater degree than usual upon expert local knowledge.

TRISTAN DA CUNHA AND ITS BIRDS

stan da Cunha: the Lonely Isle

Erling Christophersen. With Contributions by A. Munch, Yngvar Hagen, S. Dick Henriksen, eider Sognnaes, Erling Sivertsen, J. C. Dunne, Egil Baardseth, Allan Crawford. Translated from the Norwegian by R. L. Benham. Pp. xii + 244 + 15 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1940.) 12*s*. 6*d*. net.

On Tristan da Cunha 188 men, women and children live healthy, happy lives on what has sometimes been called the Lonely Isle—for Tristan is 1,400 miles from the African coast and 1,700 miles from the nearest point of South America. This very remote island received its name from the Portuguese mariner Tristão da Cunha, who was the first man to look upon its 6,000 ft. volcanic mountain which rises, sheer and frowning, from the tumultuous ocean.

The history of the colonization of the island is interesting. When Napoleon was exiled to St. Helena, the British Government sent a detachment of Hottentot soldiers to guard the island against Napoleon's friends, who, it was rumoured, were to use it as a base from which to rescue him. The Hottentots left Tristan da Cunha after a year, but their Scottish corporal, William Glass, remained behind and was the founder of the present colony. To Tristan, in 1938, a Norse expedition, not without considerable difficulties, made its way, and the book under review, a translation from the Norwegian, gives an account of the scientific work carried through by the members of the expedition. The book is on the whole well translated, but here and there, in the naming of birds, difficulties occur. For example (p. 77) it is mentioned that "the small isles of the Tristan group are the only known breeding grounds of the petrel in the world". It is obvious that the translator has fallen into error here. It would seem probable that for "petrel" the translator should have written "great shearwater" (*Puffinus gravis*). This shearwater has a remarkable history. It has been shown in Murphy's "Oceanic Birds of South America", on the authority of Wynne-Edwards, that in the northern hemisphere spring the great shearwater leaves the South Atlantic, crosses the tropical oceanic zone with great swiftness, reaches Davis Strait by early June, and in August arrives at its most northerly limit, in Greenland waters. This is a vast flight to carry through each year, but there is reason to suppose that the great shearwater may nest at a longer interval of time than a single year, and that each bird may not return to its nesting islands in the Tristan group with each recurring season.

Although we are left in doubt as to the exact identity of the birds, there is a graphic account of the petrel's song (p. 72 *et seq.*):

> "An immense flight was coming in from the sea that evening, first a few thousand which began the song accompanied by the birds which had remained at home and which now greeted the newcomers. But the song rose until tens of thousands were curvetting above our heads before the sun went down. In the twilight hundreds of thousands reached the island and their song rose to a roar.
>
> "The concert reached its highest pitch before darkness set in. We had to admit that there really was a beautiful musical effect in these voices, which first seemed near when a solitary petrel flew low over the tent, delivering the whole verse so that we heard each word, and then far away, when the murmur of the hundreds of thousands blended into one song beneath the stars."

On p. 112 is an account of the small flightless bird known as Atlantisia which, we are told, lives only on Inaccessible Island of the Tristan group and has not before been described in a book. The small bird is nocturnal, and in its home in dense vegetation is most difficult to see, let alone capture. One could wish that the account of the first meeting with Atlantisia were more full.

> "First of all only two fiery, deeply-set eyes were visible, then the light of my torch suddenly shone on so tiny and frail a creature that I felt I must be dreaming. Had I dared I would have pinched my arm. . . . I was reminded of a little photograph of a kiwi."

Seton Gordon.

Babes in the Darkling Wood

By H. G. Wells. Pp. 399. (London: Martin Secker and Warburg, Ltd., 1940.) 9*s*. 6*d*. net.

MR. H. G. WELLS has done much to raise the prestige of science among the people. Here, at the age of seventy-four, he is still trying, with the intensest energy, to communicate to the generality of mankind the implications of science. In his latest book he has used the technique of the novel of ideas to represent the attitude of young people to current events, and suggest what line they should pursue in the light of modern psychology. The ideas of Pavlov and Freud are discussed at length through the dialogues of the characters, but though an impression of their importance is conveyed successfully, they are not very clearly explained.

Mr. Wells recommends that the problem of modern life should be approached in the spirit of the sculptor who contemplates a block of uncarved marble. The possibilities in it should be conceived by a flexible imagination, and all should hack away at it until they have carved out the figure of society that they desire. The advantage of this approach is that it precludes doctrinaire planning. The sculptor is unable to make a finished preliminary draft of the three-dimensional end at which he aims, and must trust to the guidance of intelligent imagination in the course of his work. But this does not prevent him from having some drafts, and a model in his imagination which undergoes continual adaptation and is therefore living. Though Mr. Wells tends to become ever more discursive, his belief in the future and continual wrestlings with the present are still a major inspiration. J. G. CROWTHER.

Qualitative Organic Chemistry

By Neil Campbell. Pp. ix+213. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

THE isolation of pure organic compounds and the common criteria of purity are first discussed. An account of preliminary tests for classifying the unknown compound is then followed by details of more specialized confirmatory tests. Next, a review of the properties of various organic types is associated with information on the choice of derivatives suitable for the identification of specific members of each class. Practical methods for preparing thirty-two kinds of these derivatives are then given, this chapter in particular being provided with many references to the literature. A short note on the examination of mixtures concludes the first part (100 pp.) of the book. The second part (98 pp.) consists of a series of classified lists of various groups of organic compounds, with summaries of the properties of the individual substances and useful derivatives. A short bibliography and indexes are also included.

This is a thoroughly sound and up-to-date little book; besides acting as a handy and dependable *vade mecum* in the laboratory, it will stimulate its users to refer to standard works and original papers, and in general to turn to full account the educative value of this important field of practical organic chemistry. J. R.

L'Origine des cellules reproductrices et le problème de la lignée germinale

Par Prof. L. Bounoure. (Collection des actualités biologiques.) Pp. xii+272. (Paris: Gauthier-Villars, 1939.) 100 francs.

WHILE, perhaps particularly in Great Britain, most of the recent work on the reproductive cells has been concerned with the intimate structure of the chromosomes and their behaviour during fertilization and division, and with the consideration of certain extra-nuclear structures, Golgi bodies, etc., the questions of the history of the germ cells themselves and their relationship to the corresponding cells of their parents have continued to occupy the attention of zoologists. The time was ripe, therefore, for a review of these lines of research, and it has been provided by Prof. L. Bounoure, who is well known for a succession of papers in this field. Previous workers, including Jäger, who first used the expression "Continuität des Keimplasmas" in 1877 and not Weismann as is generally believed, had put forward speculative theories on the subject. The first to realize the problem definitely and to investigate it scientifically was M. Nussbaum in 1880. The present volume, after a historical introduction, reviews the whole subject of the origin of the germ cells and germinal continuity in an exhaustive manner throughout the animal kingdom. The account is fully documented by quotations of the crucial statements and contains discussions of the theoretical questions involved. It is a most useful and readable publication.

Special Surgery in Wartime

By D. W. C. Northfield, Dr. Douglas McAlpine, Dr. V. Zachary Cope, T. Holmes Sellors, A. B. Wallace. (*The Practitioner* Booklets.) Pp. vii+74. (London: Eyre and Spottiswoode (Publishers), Ltd., 1940.) 6*s*. net.

THIS little book provides a concise but comprehensive description of the most important types of war injury. Mr. D. W. C. Northfield has given an excellent clarification of the relations between the clinical picture and the underlying pathological changes in head injuries, and his summarization of the treatment is most helpful. Dr. Douglas McAlpine has surveyed spinal cord lesions well, but although he quotes Watson Jones, he has failed to emphasize the types of injury in which it is dangerous to reduce the deformity by manipulation and in which open reduction is necessary to prevent either the onset or progression of a paraplegia.

Mr. Zachary Cope and Mr. Holmes Sellors, on abdominal and chest injuries, should be read by all.

The treatment of burns at the moment is undergoing startling changes, and, although Mr. A. B. Wallace has written along the orthodox lines, his article will quite soon be out of date. For example, he still recommends tannic acid in the treatment of burns of the hands, and no mention is made of more modern methods of treating third degree burns by saline baths, irrigation in Bunyan-Stannard bags, etc.

Finally, a most useful appendix summarizes the uses of the sulphonamides in war surgery.

Starch and its Derivatives

By J. A. Radley. (Monographs on Applied Chemistry, Vol. 11.) Pp. x+346. (London: Chapman and Hall, Ltd., 1940.) 22*s.* net.

OF vital interest to the plant and animal physiologist and to the biochemist, starch has assumed a position of great importance also in applied chemistry and industry. To this latter domain this monograph properly belongs, and it is the latest of a series initiated by Dr. E. Howard Tripp with the intention of bringing together into one volume the mass of scattered literature, both old and new, which is of real value to the technologist in selected fields of chemical industry. This is a service which is widely acknowledged, and the present volume will be welcomed by many readers.

The subject of starch touches numerous and varied industries which are often exceedingly remote from one another; and the uses to which starch and its derivatives are put is some index of the very diversified character of the researches on this subject. The original literature is perhaps more voluminous than that of any other natural product. Those who have an interest in this field will therefore be grateful to the author for collecting into a single volume a body of knowledge on the manufacture and industrial applications of starch and the products derived from it.

Those sections devoted to dextrins and gums and to the general examination of starches, including their detection and chemical evaluation, are especially noteworthy, as are also the plates contributed by Mr. E. Young reproducing photomicrographs of starches of different origin.

The interests of the textile and paper industries, and the preparation of adhesives, receive more attention in this monograph than does the fermentation industry, which is a field too specialized for intensive treatment in a volume of this kind. A valuable and welcome feature is provided by the wealth of original references which are printed at the end of each chapter. It will be recognized that the merit of the different sections, treated so comprehensively, is a little unequal. That devoted to the structure of starch includes a review of some experimental data which have been superseded and could preferably have been excluded; and generally one wishes that the author's selection of material had been more critical.

A Handbook of Malaria Control

By R. Svensson. (Published by the Shell Group of Oil Companies.) Pp. viii+74+6 plates. (London: Ross Institute of Tropical Hygiene, n.d.) n.p.

THIS useful little book by an assistant director of the Ross Institute of Tropical Medicine is primarily intended for laymen, especially planters, engineers and others, who have to undertake anti-malarial work in the tropics, but it may also, as Sir Malcolm Watson remarks in the preface, be of use to medical practitioners. Within a small compass the book contains a generous quantity of valuable information, including not only an account of the different forms of malaria control but also a general survey of the malaria problem, notes on the various species of anophelines, laboratory equipment and methods, and a bibliography of recent British writers on the subject. The publication of the work has been undertaken by the Shell Group of Oil Companies.

Organic Syntheses

An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 20. Pp. v+113. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 10*s.* 6*d.* net.

SOME forty substances are handled in this volume, of which one (sodium amide) is inorganic. Preparations of open-chain compounds include those of acetylacetone (by the boron trifluoride and sodium ethoxide methods), fumaryl chloride, tertiary butyl acetate (using acetyl chloride in presence of dry ether and magnesium), and the methyl esters of myristic and palmitic acids from the wax of the bayberry (*Myrica cerifera*). Among substances of biochemical importance, preparative details are given for the *dl*-forms of cysteic acid, serine, threonine, and valine; moreover, glucose is used as the basis of penta-acetyl-*d*-gluconontrile, *d*-arabinose, and 2,3,4,6-tetramethyl-*d*-glucose. Some of the most interesting heterocyclic items are 1,2,3-benztriazole, dehydroacetic acid, 5,5-dimethylhydantoin, 5-nitroindazole, and picolinic acid hydrochloride. A useful selection of aromatic substances includes terephthaldehyde (from *p*-xylene), 2,2′-dinitrobiphenyl (from *o*-chloronitrobenzene and copper bronze), diphenylketene (from benzil monohydrazone), monoperphthalic acid, and mandelamide (from the acetone condensation product of mandelic acid, by ammonolysis with liquid ammonia in Dewar flasks). From the fact that the index covers volume 20 only, we infer hopefully that Collective Volume II, including annual volumes 10 to 19, is now in course of preparation.

J. R.

Plant Physiology

By Meirion Thomas. Second edition. Pp. xii+596. (London: J. and A. Churchill, Ltd., 1940.) 21*s.*

THE first edition of this valuable text-book was reviewed in NATURE of June 20, 1936, p. 1012; we are pleased to know that the book was so well received as to make a reprinting necessary in 1937 and now a second edition appears.

The general arrangement of subject-matter remains unaltered, though, of course, certain recent advances in plant physiology have been incorporated in the new edition. The chief of these include respiration, oxidation enzymes, the zymase-complex, absorption of solutes, translocation and storage of solutes in the cotton plant, mineral nutrition, composition of chloroplasts, reactions in photosynthesis and plant hormones.

Although certain deletions have been made, about a hundred pages have been added to the text and the price has been increased from 14*s.* to 21*s.*

ENGINEERING PROGRESS AND THE SOCIAL ORDER*

BY DR. FRANK B. JEWETT AND DR. ROBERT W. KING
BELL TELEPHONE LABORATORIES

THE recognition is universal that a systematic investigation of Nature and a practical application of the resultant knowledge have placed new tools and new weapons of great potency in man's hands. The importance of science in shaping the daily course of events has been made known to all, partly through the literature of technology, but chiefly by the instrumentalities themselves and their omnipresence in our daily lives.

One of the incidental results of modern scientific research is that it has emphasized as never before the gulf which separates the remarkable powers and the equally remarkable shortcomings of the human mind. In the face of these shortcomings we must all have wished at times that they were not immutable, so that something might be done to improve the breed, as it were. Some people have an implicit, if not indeed an explicit, faith in the pliability or tractability of human nature, which leads them to believe that peoples as a whole can be raised morally and therefore be made less willing to engage in the type of conduct of which the world to-day displays too many illustrations. But our own experience—concededly limited—has forced us to the conclusion that human nature, in the aggregate and on the average, is about as unchangeable as any of the quantities and forces with which we have been surrounded and with which we have to deal. If there is any way out from the morass of conflict and doubt in which we now struggle, it would be our opinion that it must involve changes elsewhere than in the fundamental unit which man himself constitutes.

As a result of some two centuries of evolution, scientific method has become the most powerful intellectual tool in man's possession. It is based upon the principle of consciously controlling experimental conditions, to the end that only selected factors or parameters are allowed to vary simultaneously. Long success has demonstrated that such a method supplies the firmest foundation, not alone of exact measurement but even of meaningful measurement. Controlled experiment has brought to light prolifically the exact interrelationships manifested by natural forces. The procedure is one which eliminates all speculation and guesswork from the end-results of science, while still permitting ample play to these processes of thought in the exploratory operations which comprise the chief work of the man of science and engineer. Surrounded as we are with detailed supporting evidence, it is not necessary to emphasize that the experimental method as employed in modern science has met the most stringent pragmatic tests, and that only through it could the full measure of usefulness—and, conversely, of harm—which resides in the agencies of Nature have been made available with the rapidity which is now historic fact. While the logical and practical justification of the scientific method is so universally recognized in itself to call for no particular comment, the human mechanism which has evolved *pari passu* for the more effective carrying out of the method does provide much material for profitable reflection.

Immutability and irrevocability are fundamental characteristics of the facts of science, and facts once brought to light do not change, nor is it possible, once they are understood, to force them back into the limbo of the mysterious and the unknown. It would seem to follow that to the extent to which the evolution of science has demonstrated the need for certain types of human organization and human collaboration in order to be effectively conducted, these also might find a permanent, even an expanding part, in our daily affairs. In fact, it seems inevitable that through the evolution of the various sciences we will be led to create a new science—that of human organization. A considerable amount of empirical information is already at hand, but there is urgent need that it be expanded and made suitable for wider application. The recent course of events in the study and application of the exact sciences reveals what may well be a most significant trend, which of itself is innocent enough but when we come to envisage its counterpart in another field of activity, namely, that of military affairs, and on a much larger scale, forces us to the conclusion that a very difficult situation has already been created.

As science has expanded, carrying with it the range of human knowledge—an expansion which within a single century has reached fabulous proportions—the limitations of the individual mind have become more and more apparent. The pressure of these limitations has in turn expressed itself in the instigation of organized effort on the part of those engaged both in fundamental science and in its applications. More and more, due to his inherent limitations, the individual worker is being replaced by a carefully chosen corps, the various talents of which dovetail together and the collective knowledge and collective analytical powers of which greatly exceed those of any single member of the group. When working as a unit, the capabilities of such a group, measured by results, are likely to exceed by a considerable margin the sum of any individual achievements possible to its members. In essence it is the principle of the division of labour applied in the intellectual field, a principle that has long characterized that of manual labour.

---

* Substance of an address delivered on September 18, before the Section on Natural Sciences of the University of Pennsylvania Bicentennial Conference.

It is in the field of the practical applications of science that the need of machinery for collaborative effort has been longest felt and most recognized. We surmise that this has in part been due to the fact that many of the problems which present themselves in the application of science are extremely complex, with respect to the detail they involve, and in part to the fact that a profit motive has added incentive to their accelerated solution. The chemical industries and electrical communication are among the outstanding examples that display the need and the possibilities of group attack.

It might be mentioned that the laboratory which functions within the Bell Telephone System comprises about 4,500 employees, one half of whom are skilled scientific workers and technicians, while the remainder include laboratory assistants and the necessary service groups of various sorts. Experience speaks so strongly that to-day no verbal argument is needed to justify the existence of such a centralized research and development organization.

But it becomes increasingly apparent every day that problems of so complex a nature as to demand organized attack are not peculiar to industry. Problems of this calibre are indeed becoming more and more the substratum of our daily lives and in increased proportion as we base our livelihoods upon the closely inter-related routines demanded by an industrialized society, and as we augment human effort at every turn with the facilities of the machine, as well as the involved chemical and physical processes which Nature has placed at our disposal. In the face of our growing involvement in the results of our own activity, our choice must either be to run the risk of temporizing, or to undertake purposively to improve our organizational forms with the aid of which we may entertain a reasonable hope of matching our analytical powers to our problems as they grow in intricacy.

Recent experience shows that these problems are by no means limited to the domestic range, and that frequently they will arise as a result of conflict between domestic and international relationships. Isolation in to-day's mechanized world is as unattainable as it would be impossible to extract the detonating force from an enemy's explosives or lifting power from the atmosphere that now supports his aeroplanes. Current events prove clearly enough that unless the peoples of the world can by universal agreement impose an artificial simplicity upon our social, economic and political problems, those groups and nations who are backward in the development of organizational techniques and who choose to try to cope with their problems by outgrown methods, must expect to suffer the unenviable consequences of inefficiency. Barring the ratification and enforcing of such artificial restrictions—and the possibility of so doing seems forlorn indeed—we must recognize that the urgent need is to adopt and exploit all modern fact-finding instrumentalities to their full capacity.

In support of such a programme we would urge that the method of the industrial laboratory is already proving productive when thus transplanted. We may now witness it in action on a nation-wide scale. Germany, under the Nazi regime, has become none other than a vast laboratory dedicated to the perfection, not of the arts of peace, but of the arts of war. It is not necessary to postulate any unusual skill at organization to explain the startling character of recent Nazi military achievements. The answer lies in the simple fact that the present German technique applies systematically and energetically to the affairs of a nation at war the precise methods which have characterized much industry for a generation or more. We frequently refer to it as German thoroughness. It does, of course, represent thoroughness—the kind of thoroughness which characterizes the well-managed industry with adequate research facilities. In the case of the Nazis, their organization includes virtually the entire home population plus their numerous agents abroad. We have the strongest possible proof that to wage a modern war successfully involves detailed co-operation between all a nation's population groups.

We are acquainted in general terms with the uniformity of control that the war effort exercises over every activity of German life. It is not a prospect which appeals to those of the liberal persuasion. But however much we rebel at the thought of complete submersion of our individual lives and privileges in a war-making machine, we must recognize that what we are witnessing is a battle between types of organization. In war the totalitarian State is proving itself a most potent adversary. It may, in fact, go farther than this and prove also to have great survival power following war, unless perchance experience ultimately discloses that every branch of the human race without exception is so constituted as not to submit for long to the degree of dictation and regimentation that totalitarianism involves.

But for the moment we cannot safely assume that mankind will shortly, or even in the long run, display such uniformity of taste. All we know is that dictatorship has never long endured, but has always proved the prey of disruptive forces working either from within or from without, or both. However, we must not be guilty of an over-optimistic assumption at the present time, for it is being forcefully brought to our attention by current events that through science and engineering the essential paraphernalia of dictatorship are much more readily to hand than ever before and are much more effective.

Recognizing these manifestations of modern technology, it is abundantly clear that the peoples of the world are faced with the need of making certain momentous decisions, and making them quickly. No longer can we regard with indifference the effort needed to overthrow an established dictatorship, even after it has become utterly repugnant to its subjects. We face two very unpleasant potentialities in the fact that a small but well-organized and equipped minority can impose its will on a much larger majority. We have already seen this happen within national boundaries in the case of each of the totalitarian States. But what is more significant, we are now beholding such an entrenched minority extend its sphere of conquest to much larger circles beyond its own national boundaries.

The future consequences of these recent developments are not easy to gauge. It does seem essential, however, that we make a new accounting of political methods and instrumentalities to the end that we are enabled to select those best suited to the conditions imposed by present-day technology. Our inherited social techniques give evidence of having lost an important measure of contact with reality. In an ideal sense we may still applaud Franklin when he said, "They that give up liberty to obtain a little temporary safety deserve neither liberty nor safety." But the vital fact for us who live to-day and which has asserted itself since Franklin's time is that a minority who are willing to sacrifice their own liberty—or who perhaps have been so unlucky as unintentionally to sacrifice it—can compel a majority who cherish it to lose theirs. The only effective avenue of escape seems to be to find some way of preventing the minority from giving up their liberty. If this is not done only a Hobson's choice remains, so far as the majority is concerned. They may elect either to lose their liberty by being worsted in a struggle for which they are improperly prepared, or they may, by submitting in large measure to totalitarian methods, put themselves in condition to resist attack successfully. Hence, the mere existence in the world of a totalitarian State of any magnitude, when coupled with the threat of war which history shows is always inherent in the concentrated power of dictatorship, constitutes a death threat to all liberal forms of government. Now that mankind is in possession of the weapons made possible by modern technology, the planet has suddenly grown too small to support simultaneously the type of totalitarianism and the type which we associate with liberalism. To combat the Nazi 'total war', there is only one possibility—that of *total peace.*

The foregoing argument would only be strengthened were we to consider such additional factors as wage, price and profit controls. Here again the liberal State as it now operates is at a distinct disadvantage. The authority necessary to establish such controls is entirely repugnant to the democratic way of life, except in so far as they can be worked out by voluntary acquiescence on the part of the individual. Yet the energetic waging of war—and in fact the energetic waging of commercial war in times of nominal peace—must involve the equivalent of these authorities in the highly integrated modern industrial State and also in the world at large. In a word, unless the democracies and would-be democracies can dictate and control the rules of the international game of give-and-take, they are likely to prove but pawns in the hands of the totalitarian powers, *if any such there be.*

To us who have, as we have, witnessed the rise of modern technology and who have been intimately associated with the rapid development of technology, it seems transparently clear that we of the free nations must alter in a fundamental fashion our methods of solving social and political problems. We would urge upon those who would preserve liberalism that it must make available to itself the type of instrumentality which has been found so prolific of results in science and engineering, and which in Germany we see turned so effectively to the destructive operations of war.

As to whether the State founded upon dictatorial authority represents a continuing type, it seems only safe to assume that at least potentially it will remain a serious menace to all democracies. In the first place, it and the planned economy are essentially one and the same thing. It has frequently been pointed out that national planning, irrespective of the innocence with which it is launched or the beneficent ends held in view, will inevitably lead to dictatorship provided the political authority is created to enforce the plans when once they have been made. Time does not permit our retracing the argument to-day; we will say, however, that it appeals to us as having strong presumptive validity, and the conclusion immediately deducible therefrom is significant as regards our present discussion. The increased complexity of function which is being imparted to our social, industrial and political life by a growing technology, demands on one hand a wider variety of specialized training and skill, while on the other it calls for closer co-ordination between these specialized groups to the end that more rigidly guided and more narrowly confined spheres of action are imposed upon the individual, be he human or corporate. Such expanding specialization connotes planning, while the expanding need of guidance suggests dictatorship. We see, therefore, that the two conditions are likely to merge *unless* great care is exercised to hold them apart.

A great deal hinges upon that word 'unless'. What procedure is at once compatible with freedom of action on the part of the individual and yet with the need of circumscribing and directing his activities ? The field of choice cannot be a broad one. In fact, it seems to resolve itself into one single possibility, that of voluntary and educated guidance imposed by the individual himself, and therefore in turn by public opinion.

Whenever we make the attempt, dispassionately, to contrast the extremely casual, not to say misinformed, methods usually employed by representative Governments in transacting their public business, with the painstaking studies which underlie most operations of private business, we cannot but be amazed. It is probably safe to say that, as concerns the United States, our Federal Government frequently spends tens or even hundreds of millions of dollars after less examination of the merits and ultimate soundness of a scheme than a private corporation would put into the planning of a very minor mill or factory. The lack of any threat that the supply of public money would run short has, of course, permitted the continuance of such a casual policy long after it became apparent for other reasons that the operation of Government on the basis of popular whim and fancy and political self-interest could only end in absurdity, if not in disaster.

Suddenly the evidence has swelled to such a volume that we are perhaps in some danger of being confused and misled by its very bulk. As never before, it seems that liberally inclined peoples must put their faith in the more effective pursuit of knowledge and the possibility of popularly interpreting this knowledge once it is obtained. Quite obviously, this second point is as important as the first ; knowledge in possession of a few who are without authority is powerless, while knowledge in the possession of a few with power to employ it is totalitarianism. Understanding must be the possession of the people if they are to retain their sovereignty.

As to an agency to be employed in the more effective pursuit of the knowledge which efficient and effective public management presupposes, we have already intimated that the modern industrial laboratory offers an admirable starting-point. It is the function of such an institution to bring together in intimate association a considerable number of experts and technicians whose professional knowledge and skills, when merged in harmonious co-operation, possess a productive capacity of proved merit. In fact, it seems to hold the one and only key to such enigmas as baffle the world to-day. Blocked by Nature in any effort to add materially to human intellectual capacity in a sufficiently short space of time, the alternative is to resort to the development of an organizational device for achieving the same end —a process not inappropriately termed super-organic evolution.

Nor should we be discouraged by the very obvious fact that the methods of attack in regard to problems of State must in one fundamental respect differ from those employed in technology. As previously pointed out, the basis of the experimental method is deliberate control of the factors and parameters which enter into any problem. This is quite possible when dealing with the inanimate forces of Nature, but there will be scant opportunity for the employment of such arbitrariness when studying the questions set by her animate creations. This limitation assuredly makes the approach more difficult, but certainly does not rule out the attractiveness of the mass attack ; if anything, it makes it more imperative. By the same token we must not be discouraged by the observation that while the problems of technology are in considerable measure quantitative and therefore susceptible of being stated in concrete and uncontrovertible terms, the problems of government, in proportion as they are difficult, defy reduction to simple methods of measurement. Here again, as the challenge mounts, the need for organized study and analysis surely increases.

We come now to a process that would be common to the duties of all properly directed laboratory groups, namely, that of reducing their findings to terms suited to general consumption. One of the commonest charges against the man of science is that while he may be very successful in discovering new facts, he is likely to fail or be indifferent to the description of them in terms which the so-called popular audience can comprehend. Whether the fundamental scientist, who is primarily engaged in charting unexplored territory is justified in more or less disregarding the charge—and we must all agree that in large measure he does disregard it—the problem is one which the successful industrial laboratory cannot set aside. Its principal duty, in fact, is so to interpret its findings and conclusions that management, who while highly skilled in many essential ways is not likely to be skilled in scientific principles and terminologies, can make its decisions intelligently in so far as they ought to take the work of the laboratory into account.

It is obvious that in all matters relating to technical consideration the laboratory is, or ought to be, supreme. Its purpose is clearly not to attempt to carry out the whims of management; its duty and prerogative are to develop and urge new instrumentalities and to advise management in its technical capacities as to what projects may be embarked upon with reasonable assurances of technical success. In a very real sense, therefore, orders go from the laboratory up to management. Nevertheless, the duties and responsibilities of management remain clearly defined. In the last analysis, all decisions are within its province and are its proper function. Aside from the aspects of the business which the work of the laboratory does not touch, it is the duty of management to decide what products of research shall be introduced into circulation, and when, as well as what in general, the future projects of the laboratory shall be. Decisions such as these are clearly of vital importance to the welfare of any business, and a management that is well advised will earnestly solicit the full co-operation of the laboratory before pronouncing final judgment in the fields in which it possesses an informed opinion.

The analogy between the manner in which a modern corporation employs its laboratory and the manner in which an equally modern State might employ a similar investigative and advisory body, is surprisingly close. The only outstanding difference—and it is one which would not appear to be especially significant—is that in this hypothetical modern State the public is served by a corporation around whose board it occupies all the directors' seats, and the democratic tradition therefore prescribes that it shall select its own management. There need be no resulting confusion. This is precisely the allocation of powers and duties which is contemplated in the formula, "Government of the people, by the people and for the people". Whatever advisory and investigative bodies the management of the State—which is therefore Government—is authorized to create, the public as its own board of directors will be in possession of the findings of such bodies and, moreover, can demand that management properly employ them in its acts and policies.

The purpose of this very brief discussion is to accomplish a twofold objective: first, to suggest that in the present confused state of world politics there is an acute need of the fullest understanding attainable; secondly, to point out that an instrumentality of demonstrated efficiency is available as a pattern. It is not our intention to venture any detailed suggestion as to the various organizational mechanisms which might be set up to accomplish the results which we envisage must be accomplished if the liberal form of government is to maintain its workability. At the same time we would not imply that the organizational mechanism to be created is anything short of being extremely difficult. Its solution will quite obviously call for a very high order of statesmanship and political invention. Certain models and experience are already available. As regards certain fields of science, routines are now in existence whereby an independent and highly competent group of experts may render advice to the Federal Government. These routines had their origin in problems arising during the Civil War, and with certain additions the routines have remained in effect. The group of experts who are on call as consultants are members of the National Academy of Sciences, or are such other experts as the Academy may choose to select. During 1917 the pressure of war work became such that need of closer advisory routines led to the creation of the National Research Council, a body subsidiary to the National Academy of Sciences and one which has remained in existence. Finally, as a result of the present crisis, the machinery of co-operation between the Federal Government and American men of science has been further enlarged by an Executive Order creating the National Defence Research Committee.

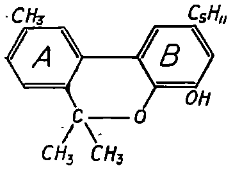
It is interesting that it has been war or the threat of war which has led to the creation and the elaboration of this machinery as well as to the periods of its extensive use. Our own view is that we are now well launched upon an era during which all of the existing advisory aids to the Government, as well as others still to be created, will have to function almost continuously. Thus, a prototype is already available, and when urgently needed enlargements are made, the Government, as well as the public which it serves, ought to be in a position to summon throughout the entire gamut of its civil activity the aid of the recognized experts of the nation. Such an arrangement need not savour of bureaucracy. But sovereign people will still remain sovereign. The belated and constructive recognition will be given to the fact, now abundantly clear to all, that the day is gone, and probably for ever, when a successful State can base its policies upon clamour of pressure groups or upon the uninformed beliefs of the majority, even though measured numerically by tens of millions.

CHEMISTRY OF THE HEMP DRUGS

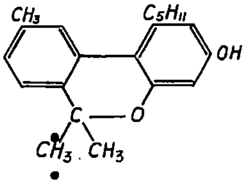
By Prof. A. R. Todd

University of Manchester

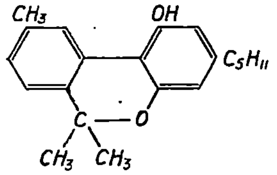
THE resinous exudate from the female flowers of the hemp plant (*Cannabis sativa*) has for centuries formed the basis of a variety of narcotics known under a host of names (charas, hashish, ganja, etc.) according to locality and mode of preparation. The hemp drugs are eaten or smoked, the effects varying somewhat accordingly. Recently the smoking of hemp under the name of marihuana has attained particular prominence in America, where strenuous efforts are being made to combat its spread. Of all the common addiction drugs, least of a scientific nature is known about Cannabis, and this despite the fact that it has quite remarkable pharmacological properties. The isolation and characterization of the active principle or principles might well prove of considerable medical importance.



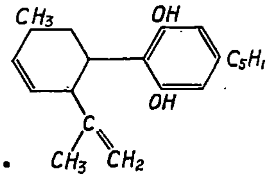
I



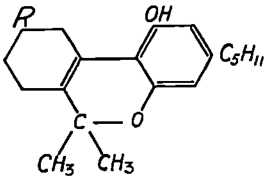
II



III



IV



V

The reason for this lack of precise knowledge lies mainly in the intractable nature of hemp resin, although the difficulty of accurate biological assay and wide variations in the potency of various drug samples have in the past also contributed. The active constituent is contained in the high boiling portion of the resin, is nitrogen-free, and can be distilled in a high vacuum without decomposition. Much of the work done by earlier investigators was invalidated by their failure to realize that this distilled product, despite its fairly constant boiling point, is not homogeneous but contains a mixture of closely related substances. The first definite advance in the chemistry of the resin was made by Wood Spivey and Easterfield[1], who isolated from it, as a crystalline acetate, the compound cannabinol. Cannabinol is a cryptophenol of formula $C_{21}H_{26}O_2$, and it was investigated, later by Bergel[2] and Cahn[3]. The latter, in a series of elegant investigations, went far towards the elucidation of its structure; he was able to propose for cannabinol the structure (I) in which only the positions of the *n*-amyl and hydroxyl groups in ring *B* of the dibenzopyran system remained uncertain.

Following the work of Cahn, several years elapsed during which little chemical advance was made, although much valuable work on distribution and potency was carried out in various laboratories. The subject was reopened by Work, Bergel and Todd[4], who showed that cannabinol could readily be separated from Indian hemp resin (ganja) as a crystalline *p*-nitrobenzoate. They established, using the Gayer test[5] on rabbits, that cannabinol was not the pharmacologically active component of the resin, and effected a considerable concentration of the active cannabinol-free material by chromatographic analysis. They did not, however, claim homogeneity for their most active products. In subsequent work in my laboratory concentration by the same means has been carried to a point where the products give a positive Gayer test at a dose of 0·05 mgm./kgm. It was also observed that the so-called Beam test (red-violet colour with alcoholic potassium hydroxide) commonly used as a reaction for Cannabis extracts is not given either by cannabinol or by the active constituents of the drug[7].

Meanwhile independent investigations by Adams and his collaborators in America were in progress. These workers used as starting material the 'red oil' of Minnesota wild hemp; Todd and his collaborators, like earlier workers, carried out their investigations on prepared drugs of Indian and

Egyptian origin, which differ somewhat in composition from each other and from marihuana. From 'red oil' Adams, Hunt and Clark[6] isolated a new substance cannabidiol $C_{21}H_{30}O_2$ as its 3 : 5-dinitrobenzoate, the same substance being isolated very shortly thereafter by Jacob and Todd[7], from Egyptian hashish, where it was accompanied by cannabinol; the latter compound has also been recently obtained from American hemp[8]. Cannabidiol, which gives a strong Beam test, is pharmacologically inert and its structure has been largely elucidated in a series of papers by Adams and his co-workers, who consider it to be (IV)[13], although rigid proof of the position of one double bond is lacking. Simultaneously with the isolation of cannabidiol, Jacob and Todd[7a] reported the isolation from Indian hemp resin of a substance cannabol isomeric with cannabidiol. This substance, which gives no Beam test and has at most a trace of pharmacological action, was thought to be a partially reduced cannabinol.

The similarity in the empirical formulæ of cannabidiol and cannabinol together with their simultaneous occurrence suggest a close structural relationship, and since cannabidiol (IV) was early found to be a derivative of olivetol (5-*n*-amylresorcinol) the American workers concluded that cannabinol was probably represented by (II) or (III[9]). Meanwhile the observation that cannabinol gives a positive indophenol reaction, taken in conjunction with the earlier nitration results of Cahn, led Jacob and Todd[7b] to conclude that cannabinol could only be (I) or (III). The obvious deduction that cannabinol is represented by (III) was confirmed by the independent syntheses of cannabinol carried out by Adams, Baker and Wearn[10] and by Ghosh, Todd and Wilkinson[11].

None of the natural compounds, cannabinol, cannabidiol and cannabol, accounts for the narcotic properties of the hemp drugs. Recently, however, Haagen-Smit *et al.*[12], have reported the isolation from marihuana of a crystalline substance cannin, showing the typical activity of the drug in dogs. No details as to the nature of this substance are available, but the isolation is of great importance, and further work by these authors will be awaited with interest. Meanwhile, developments have occurred on the synthetic side which are of considerable moment. Adams and his collaborators[13] have observed that cannabidiol undergoes cyclization with acidic reagents yielding substances which have the composition of tetrahydrocannabinols and which show strong hashish activity; catalytic hydrogenation of these gives a hexahydrocannabinol which is also active though in lesser degree. Furthermore, 3′ : 4′ : 5′ : 6′-tetrahydrocannabinol (V; R = CH_3) first obtained as an intermediate in the cannabinol synthesis of Ghosh, Todd and Wilkinson[11], is also active both in dogs[13] and in rabbits[14]; the hexahydro-compound prepared from it has again a positive, if weaker, action. On the pharmacological side, collaboration is being maintained by the American workers with Dr. S. Loewe of Cornell University and by the British workers with Prof. A. D. Macdonald of the University of Manchester. Work on analogous synthetic products is being pursued, and although not yet widely extended it is clear that some structural variation is possible; thus, synthetic tetrahydro-*nor*-cannabinol (V; R = H) is also active in rabbits[14].

The fact that a variety of synthetic tetrahydrocannabinols show hashish activity lends colour to the view also expressed by Adams[13] that there may be several active constituents of this type in hemp resin, differing from each other in the position of the ethenoid linkage; cannin might well prove to be a substance of this type. Further support for this view is perhaps to be found in the fact that cannabinol-free active fractions of Indian resin have a composition corresponding to that of a compound $C_{21}H_{30}O_2$ containing one ethenoid linkage[15]. It may be mentioned finally that a consideration of the formulæ of the substances isolated from Cannabis resin suggests that they might arise in the plant by condensation of a terpene derivative with olivetol to give cannabidiol from which, by cyclization and dehydrogenation, cannabinol would be produced[7]. While such a scheme is hypothetical, evidence of its practicability in the laboratory is available, partly from the cyclization of cannabidiol to tetrahydrocannabinol, from which cannabinol can in turn be obtained[13], and partly from a new cannabinol synthesis recently carried out in my laboratory. In this synthesis pulegone is condensed directly with olivetol and the resulting pharmacologically active tetrahydrocannabinol subjected to dehydrogenation.

A number of other interesting points arising from the recent work on Cannabis must be omitted from discussion in this article. Much remains to be done before clarity is achieved; but the rate of progress during the past year has been such that one may expect a speedy solution of the outstanding problems.

[1] *J. Chem. Soc.*, **69**, 539 (1896); **75**, 20 (1899).

[2] *Annalen*, **432**, 55 (1930); **493**, 250 (1932).

[3] *J. Chem. Soc.*, 986 (1930); 630 (1931); 1342 (1932); 1400 (1933).

[4] *Biochem. J.*, **33**, 123 (1939).

[5] *Arch. Exp. Path. Pharm.*, **129**, 312 (1928).

[6] *J. Amer. Chem. Soc.*, **62**, 196 (1940).

[7] (*a*) NATURE, **145**, 350 (1940); (*b*) *J. Chem. Soc.*, 649 (1940).

[8] Adams, Pease and Clark, *J. Amer. Chem. Soc.*, **62**, 2194 (1940).

[9] *J. Amer. Chem. Soc.*, **62**, 2197 (1940).

[10] *J. Amer. Chem. Soc.*, **62**, 2204 (1940).

[11] *J. Chem. Soc.*, 1121 (1940).

[12] *Science*, 91, 602 (1940).

[13] *J. Amer. Chem. Soc.*, **62**, 2402, 2566 (1940).

[14] Unpublished results of Prof. A. D. Macdonald.

[15] Bergel and Todd; unpublished observations.

OBITUARIES

Prof. E. W. MacBride, F.R.S.

By the death of Prof. E. W. Macbride on November 17, within little more than a month of his seventy-fourth birthday, British zoology has lost a vivid and colourful personality and a distinguished worker. To the younger generation he was a member of a remarkable group of zoologists whose encyclopædic knowledge of the morphology of the animal kingdom was a matter of wonder and admiration. His outstanding record as a student shows clearly his capacity for hard work, and his later writings indicate how well he mastered and remembered his subject.

MacBride was born in Belfast on December 12, 1866. His undergraduate training was received at Queen's College, Belfast, and St. John's College, Cambridge, at the latter of which he was exhibitioner and foundation scholar. In 1889 he graduated as B.Sc. of London and two years later obtained his B.A. of Cambridge. Nor were his energies entirely devoted to science, for in his graduating year he was president of the Cambridge Union, an honour that reflects the esteem in which he was held by his fellow students.

After graduating, MacBride went to Naples, where he came under the influence of Anton Dohrn, then at the zenith of his career, and doubtless acquired his deep love for marine zoology. In 1892 he returned to Cambridge to become University demonstrator in animal morphology and in the following year became fellow of St. John's and was the first man to be awarded the Walsingham Medal for biological research. It was doubtless during these years that he laid the foundations of his wide knowledge of zoology, his eminence in which was recognized in 1905 by his election as a fellow of the Royal Society.

In 1897 he was appointed to the Strathcona chair of zoology in McGill University, Montreal, and in this city he met and married in 1902 a daughter of the late H. Chrysler, K.C., of Ottawa. He remained until 1909 at McGill and left a reputation for enthusiasm and energy which persisted for many years. In 1913 he was appointed professor of zoology in the Imperial College of Science and Technology in succession to Adam Sedgwick, and he remained there until he retired in 1934 and carried with him the well-deserved title of emeritus professor. Here he built up a well-known school of zoology that attracted workers from overseas as well as at home. During this time his eminence was recognized by the bestowal of the honorary doctorates of both McGill and Queen's Universities.

Apart from his strictly academic work, MacBride rendered valuable services to his country and to science by his work as chairman of the Council of the Marine Biological Association of the United Kingdom, the Advisory Committee of the Development Commission on Fishery Research and of the Bermuda Committee of the Royal Society. He also served on the Councils of the Royal Society and the Zoological Society, and the work of all these posts was carried out with the enthusiasm that was so characteristic of him.

His own research ranged over a wide field but his name became particularly associated with the Echinodermata, in the knowledge of which group he became an acknowledged master; and his most noteworthy general contribution to our knowledge of this group was the section on that phylum in the "Cambridge Natural History" volume published in 1906. This was and still remains about the most clear and useful account of the group available to English students. In 1914 he produced vol. 1 (Invertebrata) of the "Text-Book of Embryology" (Macmillan), in which he covered the embryology of the whole of the invertebrates and also the Protochordata in a lucid and comprehensive manner. Here his ability as a teacher is shown better than perhaps anywhere else, for, in spite of his deep knowledge of the Echinoderms, he allots to them no more space than could reasonably be expected, taking into account the relative importance of the phyla in a general scheme and what was then known of their embryology. Apart from the descriptions of the development of selected types of the different organisms, this volume also contains useful and illuminating statements, or discussions of various theoretical points, such, for example, as the biogenetic law, the interpretation of larval forms, etc. It is a definite contribution to the study of invertebrate embryology, not merely a compilation of information, and it needs to be taken into consideration by subsequent workers in this field. MacBride's critical ability also served him well in the selection, from the vast amount of material available, of just those facts that were required to provide a succinct and yet comprehensive review. In 1922 he contributed to the twelfth edition of the "Encyclopædia Britannica" well-known articles on cytology, embryology and eugenics. He also published a series of other works that have been widely read: "Introduction to the Study of Heredity", 1924; "Evolution", 1927; "Embryology", 1929; and "Huxley", 1934.

MacBride's keen mind was not satisfied with the mere accumulation of morphological knowledge, but constantly strove to deduce generalizations from the facts or to see how the current speculations accorded with them. This tendency became more marked in his later works, which, as their titles suggest, are concerned more with the theoretical aspects of biology. In the elaboration of a theory personal opinion plays a greater part than it does, or should do, in the compilation of morphological detail. Some of MacBride's conclusions did not conform with the commonly accepted, one might almost say orthodox, theories; but this did not deter him from putting them forward. He was, for example, generally regarded as the champion in Great Britain of Lamarckism or the heritability of acquired characters, although not in the crude form in which the idea was originally proposed, and there can be little doubt that this was contrary to the main trend of current opinion. This statement requires some qualification. He did not suggest that all characters were acquired or that all acquired characters were transmitted; but, and this is an important distinction, he did suggest that there was evidence, experimental and other, to show that in certain instances changes induced by external forces in the parent could be handed on to the offspring even if in a modified form. As a corollary there is the possibility that the blind acceptance of the opposite point of view will lead to overlooking or misinterpreting evidence. That these opinions were honestly held no one doubted, and when they were put forward without rancour, with his wide knowledge and his cogency, even if they did not always convince, they certainly caused his opponents to pause and take stock of their position. Such jolts to the complacent acceptance of the orthodox are of considerable value. His ideas were by no means all heterodox, and by his clear exposition of both fact and theory he had considerable influence on contemporary zoological thought in Great Britain.

Although not a large man physically, one had only to be in MacBride's presence for a short while to realize that he had a dynamic personality and a well-stored mind. In meetings and in private discussions, no matter how widely the talk might range over the whole field of zoology, he had always a pertinent contribution to make. He has left a memory of untiring energy and remarkable knowledge, and those bodies and institutions that he served will also recall his loyalty and devotion so freely given.

There is another side to his life, although this is not the place to enlarge upon it. He was devoted to his family and in recent years settled down to a well-earned retirement in Alton, Hampshire. Here he had a delightful garden and was much interested in country life, in the affairs of his locality and in the parish church. To his widow we should like to extend our sincere sympathy.

Dr. F. L. Arnot

NEWS has been received from Sydney, Australia, of the sudden death early in October of Dr. Frederick Latham Arnot, for eight years lecturer in natural philosophy in the University of St. Andrews and, since 1939, lecturer in physics in the University of Sydney. He was born on September 29, 1904, at Sydney, of British parents, his father being Scottish and his mother English. He was educated in his home University, and after graduating with first-class honours in 1927, he was awarded an exhibition at Trinity College, Cambridge, and worked as a research student in the Cavendish Laboratory under the supervision of Sir Ernest Rutherford (later Lord Rutherford). Two years later he was awarded an Isaac Newton studentship, and received the degree of Ph.D. in June, 1930, for investigations concerning the collisions of slow electrons with molecules in gases at low pressures. His later results at Cambridge on the scattering of electrons in gases and on the diffraction of electrons in mercury vapour were of great beauty and importance.

In 1931, Arnot was appointed to a lectureship in the United College of the University of St. Andrews, and in association with his fellow-workers in the physical laboratory carried out valuable experimental work on ionization in gases and vapours. In these investigations new processes of ion formation were discovered, in particular Arnot's theory of negative ion formation at metal surfaces being of outstanding importance. The results obtained have important bearings on technical problems, and are of interest in connexion with the formation of negative ions in the outer regions of the earth's atmosphere.

In 1939, he was approved for the degree of Sc.D. by the University of Cambridge at an unusually early age. He was offered and accepted a lectureship in physics in the University of Sydney, and in July Dr. and Mrs. Arnot left St. Andrews for Australia. After his arrival he at once set about the organization of research work with the assistance of advanced students, and commenced investigations on nuclear physics and cosmic ray phenomena. Mention should also be made of the great interest which he took in problems of cosmology, and a preliminary account of his views, admittedly of a somewhat speculative character, was published in NATURE of June 25, 1938. His many friends in all parts of the world deeply regret the untimely close of a promising career. H. S. ALLEN.

Prof. Julius Wagner-Jauregg

A BRIEF announcement of the death at the age of eighty-three of Prof. Julius Wagner, Ritter von Jauregg, the eminent Viennese medical man who introduced inoculation of malaria as a treatment for general paralysis, appears in the October 5 issue of the *Schweizerische Medizinische Wochenschrift.*

Like his predecessor Kraft-Ebing (see NATURE, August 10, p. 194), he was born at Wels in Upper Austria, on March 7, 1857. He received his medical education at the University of Vienna, where his chief teachers were Stricker, professor of general and experimental pathology, and Leidesdorf, professor of psychiatry. He qualified in 1880 and five years later became lecturer in neurology and psychiatry at his Alma Mater. During 1889–1893 he was extraordinary professor of neurology and psychiatry at Graz, and was then appointed professor in this subject at Vienna, where he remained until his retirement in 1928.

His early work was connected with the treatment of cretinism with thyroid extract, and of goitre with small doses of iodine. His most important achievement, for which he received a Nobel Prize in 1927, was the inoculation of benign tertian malaria for the treatment of general paralysis, which, though not devoid of risk, proved successful in about a third of all cases of this hitherto invariably fatal disease. The same treatment was afterwards applied in tabes. The method had been suggested to him by beneficial effects in various psychoses of pyretogenic substances, such as staphylococcal vaccine or tuberculin. He also was the author of works on heredity, forensic psychiatry and the somatic pathogenesis of various psychoses. A bibliography of his publications up to 1928 was compiled by Prof. A. Pilaz (*Wien. Med. Woch.*, **78**, 842 ; 1928) and his portraits at different ages appeared earlier (*Wien. Med. Woch.*, **64**, 2239 ; 1914 ; *Deut. Med. Woch.*, **53**, 417 ; 1927).

J. D. Rolleston.

We regret to announce the following deaths :

Dr. J. W. Blagden, a director of Messrs. Howards and Sons, Ltd., formerly head of the research laboratories, aged sixty-seven.

Sir Harley H. Dalrymple-Hay, the well-known underground railway engineer, on December 17, aged seventy-nine.

Prof. Robert Emden, formerly professor of physics n the Technical High School, Munich, aged seventy-our.

Mr. E. H. Hayes, formerly mathematical tutor of New College, Oxford, on December 4, aged eighty-six.

Prof. Karl Hescheler, formerly professor of zoology in the University of Zurich, an authority on the osteology of prehistoric mammals, aged eighty-one.

Dr. A. B. Lewis, curator of Melanesian ethnology in the Field Museum, Chicago, on October 10, aged seventy-three years.

Prof. Alberto Pepere, professor of morbid anatomy in the University of Milan, aged sixty-seven.

Prof. H. J. Spooner, professor of mechanical and civil engineering in the Regent Street Polytechnic during 1882–1922, on December 16, aged eighty-four years.

The Rev. Canon Alfred Young, F.R.S., formerly lecturer in mathematics in Selwyn College, Cambridge, on December 19, aged sixty-seven.

Prof. Rudolf Zeller, formerly professor of geography in the University of Bern, aged seventy-one.

NEWS AND VIEWS

ace Aims

One result of the proclamation of the Nazi "New rder" in Europe has been a widespread desire for a omparable statement from the British and Allied overnments of their intentions. A noteworthy ontribution towards clarifying the situation has een made by a letter which appeared in *The Times* f December 21 over the signature of the Archbishop f Canterbury, Cardinal Hinsley, the Moderator of e Free Church Council and the Archbishop of ork. Starting with the statement that no per-anent peace in Europe is possible unless the inciples of the Christian religion are made the sis of national policy and all social life, they base eir letter on the five points put forward by Pope us XII a year ago. The first of these requires the ssurance to all nations of their right to life and lependence" ; violation of this equality of rights mands reparation, based, not upon force, but on e rules of justice and reciprocal equity. The cond point refers to the need for "a mutually greed organic progressive disarmament, spiritual as ell as material, and security for the effective plementing of such an agreement" ; and the third phasizes the need for a juridicial institution to arantee and, when necessary, to revise, such greement. The fourth and fifth are less specific in at they ask for the adjustment of the needs of tions and populations and for the development of sense of justice in accordance with the Christian eal.

To these five points the signatories of the letter l five brief supplementary statements defining their attitude more precisely. They ask for the abolition of extreme inequalities in the distribution of wealth and possessions, for equal educational opportunity for all, and for the safeguarding of the family as the social unit. They also state that "The sense of a Divine vocation must be restored to man's daily work" and that world resources should be regarded as "God's gifts to the whole human race, and used with due consideration for the needs of the present and future generations". These simple and direct statements, coming from the leaders of the Christian Churches in Great Britain, will be received with general approval. Indeed, they crystallize the thoughts of many who have followed the present struggle, not with any doubts as to the righteousness of the British and Allied cause, but with anxious eyes for the future ; and they may well form a useful substitute for an official Government pronouncement, hedged about as the latter would be by various provisos and qualifications. The letter will be accepted by all men of good will, whether associated with the Christian Churches or not, as an eloquent statement of war—and peace—aims of the British Commonwealth of Nations and her Allies.

Colonial Policy during and after the War

Lord Lloyd's statement on recent developments in colonial policy in reply to Lord Faringdon in the House of Lords on December 17 is of the greatest moment, not only as being in the nature of an interim report on the steps which have been taken to implement previous declarations of policy in colonial affairs, but also as affording an indication of the line along which it is at present the aim of the allied powers responsible for colonial dependencies to direct future and post-war policy in inter-State relations. The British Government, earlier in the present year, pledged itself to a policy of colonial development so far as conditions might allow during the continuance of hostilities; while, in administration, liaison arrangements with the French Colonial Empire had already been brought into operation before the collapse of France. This co-operation between Colonial Governments, Lord Lloyd stated, has not only begun but is also being deepened every day during the War, and will be continued afterward when all the Colonial Governments will be free from the daily fear of Nazi aggression.

In support of this statement, Lord Lloyd was able to point to the important economic agreements which have been negotiated with the Free French colonies in Africa and with the Belgian Congo. Further, the British Colonial Office has organized within the office to continue the liaison arrangements with the French Colonial Empire. Recent developments in relations with the Dutch colonial authorities are even more striking. The British and Dutch Governments have been so strongly impressed by the results of joint discussion of problems common to Malaya and the Dutch East Indies, which have taken place both in England and between Sir Shenton Thomas and the Netherlands authorities in Batavia, that regular machinery has been set up to ensure that liaison in the form of a joint Anglo-Netherlands Committee on Economic Matters.

While these measures to promote a liaison in the important sphere of economics are a substantial beginning in the promotion of co-operation in administration between Colonial Powers, which will prove of the greatest value in planning post-War development in the Colonies under British administration, Lord Lloyd referred also to measures which, if less spectacular, should nevertheless have the practical result of assisting them in the initial stages of coping with the difficulties of the present situation. For the moment, action is directed in the main towards keeping up essential supplies in so far as is necessary to avoid war-time distress and to maintain the standard of living. Apart from special forms of assistance, financial and other, this has entailed urging upon the Colonies to grow more and better kinds of food, and in the relation of exports and imports to ensure that cash provided should be turned into essential supplies from outside. In this connexion Lord Lloyd pointed out that, in the past, the Colonies have concentrated too much on the production of some profitable export crop and have relied upon imports for their necessary foodstuffs. His predecessors, he added, for some years past had urged upon Colonial Governments the importance of mixed farming, by which the soil would be enriched and a better balance secured in agriculture. It is to be presumed that no opportunity in the future will be lost to stress the advantages of a policy for which the argument is now so greatly reinforced by the urge of necessity.

Dr. F. B. Jewett

THE resignation of Dr. Frank B. Jewett, presid
of the National Academy of Sciences, from his p
as president of the Bell Telephone Laboratories, I
in New York City, has recently been announced.
now becomes chairman of the Board of Directo
and will thus have more time to aid the U.S. Gove
ment as a member of the National Defence Rese
Committee. He will be succeeded as president of
Laboratories by Dr. O. E. Buckley, who has
executive vice-president. For the past twenty-
years, Dr. Jewett has been the operating head o
Bell System's research programme, and since
has been responsible both for the programme
its execution. He will now continue as vice-preside
of the American Telephone and Telegraph Compa
in charge of research, as such retaining his jurisdict
over these activities. Dr. Buckley, new president
the Laboratories, has been associated with telepho
research since he entered the Bell System in 19
He became director of research in 1933 and execut
vice-president in 1936 (see also p. 824 of this iss

Jacob Petersen

DR. JACOB JULIUS PETERSEN, a well-kn
Danish medical historian, was born at Rönne in
island of Bornholm on December 29, 1840.
studied medicine at Copenhagen, where he quali
in 1865. After a visit to Germany, where he wor
under Virchow and Traube in Berlin, he settle
Copenhagen. Besides his activities as a comm
doctor he delivered lectures on the history of medic
from 1874 onwards, but it was not until 1887 th
he received official recognition as a lecturer, and
1890 was appointed extraordinary professor
medical history in the University of Copenhag
His chief publications were on the contagion
tuberculosis (1869), chief factors in the histori
development of medical treatment (1876), the ol
history of clinical medicine (1889), cholera epide
with special reference to Denmark (1892), Da
medicine in the years 1700–1750 (1893), and sm
pox and vaccination (1896). He died on May
1912.

Museums and the Public

THERE is an aspect of museum work and muse
service to the community of which little is he
and which nevertheless occupies a considerable p
of the duties of the staff and is of some natio
importance. It concerns minor inquiries of ma
sorts which can be answered only by a speciali
and the answers to which may be of some value
the inquirers. Some of the miscellaneous econo
problems placed before the Department of Bota
in the Free Public Museums of Liverpool are instan
by H. Stansfield in an article in the *Museums Jour*
(40, 215; 1940). A young woman was given
cigarette, collapsed on smoking half of it and
mained unconscious for two days. The cigare
had been home-made by a man who used the lea
of a plant growing accidentally in his garden;
botanist identified the plant as Indian hemp,

rce of "hashish"; and the plant had grown from refuse of a parrot's cage containing remains of a ixture from a chance packet of bird-seed. A point nsurance was decided by the relative inflam- bility of teff grass and ordinary hay. Questions adulteration in manufactured chicory, inquiries ut possible new sources of iodine, about diseases ulbs, the qualities of timber for various specific oses, the control of weeds, the identification of ignments of unrecognized materials, indicate variety of information which is expected of a um botanist.

tile Studies at Leeds

REPORTS on the work of the session 1939–40 in Departments of Textile Industries and of Colour emistry and Dyeing at the University of Leeds w that, although the number of students, par- ularly of those from overseas, has suffered to some ent and the time-table has had to undergo con- able alteration to meet the special condi- s arising out of the War, the work of both artments has been actively carried on and an ressive list of successes in the examinations of University and of the City and Guilds of London itute has been achieved. The degree of Ph.D. conferred upon three students, one gained the c. degree and sixteen others graduated with ours. Twelve diplomas were awarded, while no r than forty-seven students obtained first class es in the examinations of the City and Guilds of ndon Institute, several of them gaining prizes and ver medals. Facilities for work by the students in tories during the vacation, which forms a valuable highly appreciated part of the training, have of essity been somewhat restricted though not alto- her suspended. In addition to the normal work he research laboratories, much of which is carried in co-operation with various firms in different s of Great Britain, much attention is being devoted problems of immediate national importance. earch activity has increased in intensity, not rely on account of the War, but also because of the reciation shown by the industry in their results. ong list of recent publications in scientific journals ppended.

est Research Programme at Dehra Dun

HE triennial programme of work, 1940–42, of the rest Research Institute, Dehra Dun, India (New lhi: Government of India Press, 1940) gives idence of the great progress made in this respect India during the last three decades. When the titute was inaugurated in 1906–7, the five branches l in force were decided upon, namely: sylvicultural, tanical, entomological, utilization and chemical. me progressed more rapidly than others, notably lization, as a result of the War of 1914–18 and the nands then made upon it. The present triennial gramme shows, however, that advances in sound est research have since made uniform progress l the branches. The brochure is inevitably some- technical in many of the inquiries and research being undertaken, but in the sylvicultural branch investigations in various provinces are being carried on into that important subject in tropical forestry 'grazing combined with forestry'; also into erosion and soil-covering and its effects. The utilization branch has been for long subdivided into wood technology, timber testing, seasoning, wood preservation, paper pulp and wood workshop. Perhaps one of the surprising things about the Institute is that the minor forest products section, which is once again in 'cold storage', as it is expressed, owing to want of staff, has never received the serious attention which it so obviously seemed to demand. It would have been thought that from very early years in the functioning of the Institute, the Department and Government would have realized the enormous possibilities of research into the very large number of minor products of the Indian forests; lac and resin have already proved the value of experimental research work. It is difficult to understand this neglect.

Riveted Joints and Welded Joints

THE quarterly journal *Electric Welding*, issued by the Quasi-Arc Company, Ltd., Bilston, Staffs., is being discontinued. Advances which may occur in welded construction or technique will be published by distribution of technical circulars or by articles in technical or trade journals. The last issue of the journal (October) contains a paper by Prof. B. P. Haigh entitled "Riveted Joints and Welded Joints", who points out that riveted joints can be relied on to meet all ordinary requirements, provided that the working drawings of the structure provide the necessary scantlings. So firmly established is this faith in riveted joints that almost any failure in a riveted structure is attributed, if not to accident, then to faulty design of the structure as a whole. A riveted structure, if neglected, may be expected eventually to deteriorate by rusting. Water percolates between the plates and forms rust, forcing the plates apart between the rivets. The rivets become tighter for a time but eventually loosen or crack, and the structure falls asunder.

Welded structures may be expected to last longer in such circumstances because overlapping plates or rolled sections can be and commonly are very efficient from the mechanical point of view; thus channel sections welded back to back and welded all round the overlap, are so strongly joined that the rolled sections yield before the joints. The use of galvanized plates is not recommended either for riveting or welding, where full strength is required, particularly in vibration. At the high temperatures required for either riveting or welding, zinc is liable to penetrate between the grains in the steel, particularly when the metal is under tension, with the result that rivets and welds are then liable to crack in a brittle manner. When welds are made between galvanized plates of fair thickness, it is expedient to grind off the layer of zinc from the surfaces that will carry the fillets; but grinding is more difficult for riveted joints and is probably impracticable.

Electric Supply in East Africa

THE report of the annual meeting of the East African Power and Lighting Co. in Nairobi, at which Major Ward presided, is now available. Major Ward pointed out that in present circumstances it is not possible to give so much detail as in the past; but as the period since the outbreak of the War has passed with remarkably little change in the conditions in which the Company has been working, it has been able to maintain progress. Results in the East African Territories are largely affected by commodity prices, which were well maintained. The past year had shown considerable increase in the development of secondary industries. In 1939 the rainfall in the Nairobi area was the lowest on record, and the Company found much difficulty in meeting the demand of its consumers, but a supply was maintained until the rains broke. Actually there was a new 1,400 b.h.p. Diesel generator, due for delivery, but the War delayed shipment of the plant, which is the largest generator of this type in East Africa. It arrived in April last. Units sold in Kenya increased from nearly 14 million in 1938 to more than 16 million in 1939. In Tanganyika Territory, the Dar-es-Salaam and District Electric Supply Co. had an increased demand, requiring an additional plant capacity, and a further Diesel set was installed.

Health Conditions in Venezuela

IN a recent paper (*Bot. Ofic. San. Panamer.*, 962; 1940) Dr. Julio García Alvarez, the Venezuelan Minister of Health and Social Assistance, remarks that the advance in public health in his country in 1939 includes the establishment of milk stations in 11 towns, of maternity hospitals in 10, the founding of a venereal disease dispensary-school, the completion of the Simon Bolivar tuberculosis sanatorium, the establishment of 40 centres by the Yellow Fever Service, and improvements in the national leprosariums and in the system of registering leprosy patients. In the campaign against malaria, 3,500 kgm. of quinine were distributed among 934 towns, and 312,985 treatments were given—two and a half times the number for the previous year. In 1939 the Ministry maintained 37 health units, a health commission, six health bureaux, 64 rural health officers and two port health officers, and its staff included 293 physicians, 14 sanitary engineers, 49 dentists, 43 laboratory workers, 244 inspectors, 294 nurses, 5 veterinarians and 1,237 unclassified employees as compared with 93, 2, 3, 26, 22, 54, 3 and 565 respectively in 1936.

The Night Sky in January

THE moon is full on January 13 at 11h. and new on January 27 at 11h. U.T. No star as bright as mag. 5·0 is occulted during the month. Jupiter and Saturn are in conjunction with the moon on January 7 at 7h. and 12h. respectively; Mars is in conjunction on January 23 and Venus on January 25. Jupiter and Saturn are near the southern meridian in the early evening. Saturn is stationary in its movement among the stars on January 10, after which the planet increases its right ascension very slowly. Jupiter's right ascension is increasing appreciably, thus bringing the two planets more closely together in the sky until the middle of February (conjunction on February 20 at 19h.). Jupiter's four inner satellites may be seen grouped most closely together at 20½h. on January 1, 4 (all eastwards), 11, 17 (all westwards), 19, 25 and 28. They will be seen widely grouped on January 8, 9, 13 and 31 (all westwards). Saturn's ring system is well presented for observation. Mars and Venus are both morning stars, the former predominantly bright in the morning skies before dawn. Clear evenings in January and February are associated with the brilliant assembly of stars attendant upon Orion. The Milky Way in this part of the sky is much fainter and less interesting than along its stretch visible during autumn evenings. During January, the night—sunset to sunrise—shortens by 1.2 hours in the latitude of London.

Announcements

DR. JEAN RAYNAL, director of the Pasteur Institute of Shanghai, has been awarded the French Commission Gold Medal in recognition of his work.

A CENTRAL institute for the investigation of foodstuffs is being erected at Utrecht to be in close association with the Institute of Hygiene.

THE second Pan-American Congress of Endocrinology will be held at Montevideo during March 5–8. 1941. Further information can be obtained from Dr. Pedro A. Barcia, Casilla de Correo 255, Montevideo.

COMPULSORY examination of students at the University of Budapest has shown that about 50 per cent are suffering from diseases such as nephritis, heart disease, tuberculosis, syphilis, etc., without knowing it.

IN 1934 the United States had only a little more than 5,000 cases of smallpox. Since then there has been a rapid increase. In 1937 there were 11,673 cases and in 1938 about 15,000. These figures indicate that, with the exception of India, smallpox is more prevalent in the United States than in any other country in the world.

THE Lac Research Laboratory of the London Shellac Research Bureau is removing from the Ramsay Laboratories, Chemical Engineering Department, University College, London. Inquiries should be sent to Mr. A. J. Gibson, India House, Aldwych, London, W.C. 2.

University of Birmingham: Air Raid Damage

INCENDIARY bombs have fallen on the buildings and in the grounds but the damage done was negligible. A part of the old building in the city which used to be the Department of Anatomy has been demolished.

The rooms of the Birmingham Natural History and Philosophical Society, which contained historic apparatus and a library of 8,500 volumes, have been totally destroyed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

An Enzyme from Bacteria able to Destroy Penicillin

FLEMING[1] noted that the growth of *B. coli* and a number of other bacteria belonging to the coli-typhoid group was not inhibited by penicillin. This observation has been confirmed. Further work has been done to find the cause of the resistance of these organisms to the action of penicillin.

An extract of *B. coli* was made by crushing a suspension of the organisms in the bacterial crushing mill of Booth and Green[2]. This extract was found to contain a substance destroying the growth-inhibiting property of penicillin. The destruction took place on incubating the penicillin preparation with the bacterial extract at 37°, or at room temperature for a longer time. The following is a typical experiment showing the penicillin-destroying effect of *B. coli* extracts. A solution of 1 mgm. penicillin in 0·8 c.c. of water was incubated with 0·2 c.c. of centrifuged and dialysed bacterial extract at 37° for 3 hours, in the presence of ether, and a control solution of penicillin of equal concentration was incubated without enzyme for the same time. (The penicillin used was extracted from cultures of *Penicillium notatum* by a method to be described in detail later. It possessed a degree of purity similar to that of the samples used in the chemotherapeutic experiments recorded in a preliminary report[3].) The growth-inhibiting activity of the solutions was then tested quantitatively on agar plates against *Staphylococcus aureus*. The penicillin solution incubated with the enzyme had entirely lost its growth-inhibiting activity, whereas the control solution had retained its full strength.

The conclusion that the active substance is an enzyme is drawn from the fact that it is destroyed by heating at 90° for 5 minutes and by incubation with papain activated with potassium cyanide at pH 6, and that it is non-dialysable through 'Cellophane' membranes. It can be precipitated by 2 volumes of alcohol, but much of its activity is lost during this operation. The activity of the enzyme, which we term penicillinase, is slight at pH 5, but increases considerably towards the alkaline range of pH. It is very active at pH 8 and 9. Higher pH's could not be tested as penicillin is unstable above pH 9.

The mechanism of the enzymatic inactivation of penicillin is being studied. No oxygen uptake occurs during the reaction, and the inactivation proceeds with equal facility under aerobic and anaerobic conditions. No appearance of acid groups could be detected by pH measurement with the hydrogen electrode. Extracts of a number of other micro-organisms, made by crushing the bacteria in the bacterial grinding mill, were tested for penicillinase. The enzyme was absent from extracts of the penicillin-sensitive *Staphylococcus aureus*, of yeast and of *Penicillium notatum*. It was present in a Gram-negative rod, insensitive to penicillin, found as a contaminant of some Penicillium cultures. Unlike *B. coli*, it was not necessary to crush the organism in the bacterial mill in order to obtain the enzyme from it; the latter appeared in the culture fluid. The enzyme was also found in *M. lysodeikticus*, an organism sensitive to the action of penicillin, though less so than *Staphylococcus aureus*. Thus, the presence or absence of the enzyme in a bacterium may not be the sole factor determining its insensitivity or sensitivity to penicillin.

The tissue extracts and tissue autolysates that have been tested were found to be without action on the growth-inhibiting power of penicillin. Prof. A. D. Gardner has found staphylococcal pus to be devoid of inhibiting action, but has demonstrated a slight inhibition by the pus from a case of *B. coli* cystitis. The bacteriostatic action of the sulphonamide drugs is known to be inhibited in the presence of tissue constituents and pus.[4] That the anti-bacterial activity of penicillin is not affected under these conditions gives this substance a definite advantage over the sulphonamide drugs from the chemotherapeutic point of view. The fact that a number of bacteria contain an enzyme acting on penicillin points to the possibility that this substance may have a function in their metabolism.

E. P. ABRAHAM.
E. CHAIN.

Sir William Dunn School of Pathology,
Oxford.

Dec. 5.

[1] Fleming, A., *Brit. J. Exp. Path.*, **10**, 226 (1929).

[2] Booth, V. H., and Green, D. E., *Biochem. J.*, **32**, 855 (1938).

[3] Chain, E., Florey, H. W., Gardner, A. D., Heatley, N. G., Jennings, M. A., Orr-Ewing, J., and Sanders, A. G., *Lancet*, 226 (1940).

[4] MacLeod, C., *J. Exp. Med.*, **72**, 217 (1940).

Morphological Effects of Penicillin on Bacteria

WHILE working with Chain, Florey and others on the inhibition of bacterial growth by penicillin[1], I noticed that concentrations of less than full inhibiting power caused a change in the appearance of the growth of *Cl. welchii* in fluid media. The normal uniform turbidity was replaced by a flocculent growth with a heavy deposit. Microscopical examination showed an extreme elongation of the majority of the cells, which took the form of unsegmented filaments ten or more times longer than the average normal cell.

I have now examined a number of bacteria grown in broth or serum broth with penicillin, and I have found similar microscopical changes in all the rod-shaped organisms that have shown any inhibition. These changes may be traceable, in the form of a distinct average lengthening of the cells, to a dilution eight or ten times, and even sometimes thirty times, higher than that which completely inhibits growth.

The Gram-negative rods, which are relatively resistant to penicillin, show the effect very well. Thus in *S. typhi*, which was completely inhibited by a 1 in 1,000 concentration, almost completely by 1 in 2,000, and partially by 1 in 4,000, an elongation of the cells, which was enormous at these two latter dilutions, could still be detected at 1 in 32,000. *Vib. choleræ*, which was inhibited only slightly at 1 in 1,000, growing as immense swollen filaments, showed appreciable lengthening up to 1 in 8,000. Similarly with the Salmonella group, *Bact. coli* and other Gram-negative rods, which often showed grotesque giant-forms due to the autolytic swelling and frequent bursting of elongated cells.

The changes are similar to and at least as great as those figured by Ainley Walker and Murray[2] in their experiments on the effect of methyl-violet and other dyes on the typhoid-coli group of bacteria.

The growth of *Brucella melitensis* and *abortus* is not inhibited by penicillin at 1 in 1,000, the strongest solution tested; nor is there any enlargement of the cells. But a vacuolation of the majority of them was seen in both species at 1 in a few thousands, and in *Br. abortus* this effect could be decreasingly traced right down to 1 in 300,000. It does not, however, seem likely that such a minor disturbance can be of great importance.

Gram-positive organisms, which are in general a good deal more sensitive to penicillin than the Gram-negative rods, show similar phenomena. For example, *Cl. welchii*, which was completely inhibited at 1 in 60,000, showed considerable filament-formation right up to 1 in a million and a half. In *Bac. anthracis* the corresponding figures were about 30,000 for total inhibition and 300,000 for lengthening.

With the Staphylococci the morphological change takes the form of spherical enlargement of the cell and imperfect fission, easily detectable at dilutions four to eight times higher than the completely inhibitory dilution, which, with a very small inoculum, may be as high as 1/800,000.

Streptococcus pyogenes, an extremely sensitive species, showed great swelling of the cells, incomplete fission with formation of large spinoles, and increased length of chains. This occurred at dilutions at least four times higher than the completely inhibiting dilution, which was 400,000. The growth was deposited, leaving a clear supernatant fluid. Several appearances were seen in *Str. viridans* at 1 in 50,000, though growth was completely inhibited at only 1 in 4,000.

I have not been able to see any morphological effect on the Meningococcus, though it is inhibited by penicillin at 1 in 50,000.

An observation by R. Tunnicliff[3] on the action of sulphanilamide on *Streptococcus viridans* probably points to a similar phenomenon. She found that the drug causes the coccus to form more and longer chains and to grow in granular form in fluid media. This change she considers to be in the direction of roughness, and adds that it "appears to make the Streptococci more phagocytable".

Thus it seems that toxic dyes, the atoxic penicillin and probably sulphanilamide cause similar morphological changes at incompletely inhibitory concentrations, and that the changes are mainly due to a failure of fission. Growth proceeds, but division and separation do not follow in due course. Many cells then fall victim to autolysis.

If the bacteria, as Tunnicliff suggests in the case of sulphanilamide, are thereby reduced in virulence, the chemotherapeutic agent can be expected to exert some action *in vivo* at concentrations much lower than those needed for complete inhibition of growth.

It should be noted that penicillin is not yet a pure substance, so that the figures given must be taken with considerable reserve.

A. D. GARDNER.

Sir William Dunn School of Pathology,
University of Oxford.
Dec. 10.

[1] *Lancet*, 226 (1940).

[2] *Brit. Med. J.*, 2, 16 (1904).

[3] *J. Inf. Dis.*, 64, 59 (1939).

Para-Amino Benzoic Acid as a Bacterial Growth Factor

THE mode of action of sulphanilamide has been the subject of much recent work. Possibly the most precise contribution has been Woods's discovery of the anti-sulphanilamide effect of *p*-amino benzoic acid ('p.a.b.'). In a discussion of this work, Fildes[1] has suggested that 'p.a.b.' might be considered an essential metabolite for bacteria. It is now inferred that sulphanilamide inactivates an essential co-enzymic grouping of the susceptible organism[1,2]; and in view of Woods's work, this grouping is most probably 'p.a.b.'. Before this hypothesis of sulphanilamide action can be widely accepted it remains to be proved that 'p.a.b.' is essential for the growth of organisms inhibited by the drug.

Previous work by Brown *et al.*[4] on the growth requirements of the butyl alcohol - acetone organism, *Clostridium acetobutylicum*, has shown that thiamin, riboflavin, tryptophane, nicotinic acid, pimelic acid, pantothenic acid, alanine and uracil, are unable to stimulate growth in synthetic media. More recently Weizmann[5] (1939) has stated that biotin was essential for the growth of this organism.

In our earlier work on the isolation of the growth factor for *Cl. acetobutylicum* a yeast concentrate was prepared which supported growth of the organisms in a concentration of 2×10^3 μgm. per ml. of a basal medium of the following composition: asparagine 0·1 per cent, glucose 2·0 per cent, KH_2PO_4 0·5 per cent, K_2HPO_4 0·5 per cent, $MgSO_4$ 0·2 per cent, NaCl 0·1 per cent, $FeSO_4 . 7H_2O$ 0·01 per cent, $MnSO_4 . 4H_2O$ 0·01 per cent, in distilled water.

Thirty kgm. of brewer's yeast (wet) yielded 750 mgm. of yeast concentrate by a procedure too lengthy to describe in this communication. An ether extract of this concentrate was evaporated, benzoylated, and the product (recrystallized five times from alcohol), was identified as *p*-benzoyl-amino benzoic acid, m.p. 277° C., yield 2 mgm. In Table 1 are recorded the results of experiments condensed from the study of nine species of *Cl. acetobutylicum*, of which seven were isolated in this laboratory and two were obtained from the American Type Cultures Collection Nos. 862 and 4259. Growth has only been recorded as positive when the test medium gave growth in five successive subcultures.

From Table 1 the following conclusions may be drawn:

(1) *p*-amino benzoic acid and its derivatives act as growth factors for *Cl. acetobutylicum*.

(2) *p*-amino benzoic acid can be recovered from a yeast concentrate factor as the benzoyl derivative.

(3) Removal of *p*-amino benzoic acid from the yeast concentrate removes its growth factor activity.

TABLE 1.

GROWTH FACTORS FOR *Cl. acetobutylicum* AND RELATED SUBSTANCES.

Substance	Amount of substance per ml. of basal synthetic medium					
	2×10^{-5} μ gm.	2×10^{-4} μ gm.	2×10^{-3} μ gm.	2×10^{-2} μ gm.	2×10^{-1} μ gm.	2. μ gm.
1. Yeast concentrate	−	−	+	+	+	+
2. Yeast concentrate (after ether extraction)	−	−	−	−	−	−
3. *p*-benzoyl amino benzoic acid (from yeast concentrate)	−	+	+	+	+	−
4. *p*-amino benzoic acid	+	+	+	+	+	−
5. *m*-amino benzoic acid	−	−	−	−	−	+
6. *o*-amino benzoic acid	−	−	−	−	−	+
7. Novocaine	−	+	+	+	+	−
8. Sulphanilamide	−	−	−	−	−	−

Growth +, no growth −

A comparison of these results with the anti-sulphanilamide tests of Woods reveals a remarkable correlation. In this work the growth factor activity is: *p*-amino benzoic acid $6{\cdot}8 \times 10^{-8}$ *M.*, novocaine $1{\cdot}2 \times 10^{-8}$ *M.*, *ortho* and *meta* amino benzoic acid probably inactive. In regard to Weizmann's statement, it is presumed that his biotin, which stimulated growth, contained *p*-amino benzoic acid.

The bacteriostatic action of sulphanilamide on growth was determined by subculturing the organisms in the basal medium containing varying quantities of 'p.a.b.' and constant amounts of sulphanilamide. The results recorded in Table 2 confirm Woods's findings[6] on the anti-sulphanilamide action of 'p.a.b.' They also illustrate how it is possible to titrate the two antagonists using growth as the end point.

TABLE 2.

TITRATION OF *p*-AMINO BENZOIC ACID AGAINST SULPHANILAMIDE.

Concentration of sulphanilamide	Amount of *p*-amino benzoic acid per ml. of basal medium					Molecular ratio 'p.a.b.' : sulphanilamide
	5×10^{-3} μ gm.	1×10^{-3} μ gm.	2×10^{-3} μ gm.	3×10^{-3} μ gm.	4×10^{-3} μ gm.	
$\frac{M}{1{,}650}$	−	−	−	−	−	23,000
$\frac{M}{3{,}300}$	−	−	+	+	+	23,000
$\frac{M}{6{,}600}$	−	+	+	+	+	23,000

Growth +, no growth −.

On the basis of the above figures one molecule of 'p.a.b.' antagonizes 23,000 molecules of sulphanilamide. This tremendous disproportion between these two antagonistic reagents makes it difficult to conceive how the growth activator 'p.a.b.' can overcome the effect of the growth inhibitor (sulphanilamide) if the two molecules are destined towards the same receptor site on the organism. The chances of the activator making first contact seem fairly remote when considered from a physico-chemical point of view.

SYDNEY D. RUBBO.
J. M. GILLESPIE.
University of Melbourne.
Oct. 22.

---

[1] Fildes, *Lancet*, 1, 955 (1940).

[2] Stamp, *Lancet*, 11, 10 (1939).

[3] Green, *Brit. J. Exp. Path.*, 21, 38 (1940).

[4] Brown, Wood and Werkman, *J. Bact.*, 38, 631 (1939).

[5] Weizmann, *Biochem. J.*, 33, 1376 (1939).

[6] Woods, *Brit. J. Exp. Path.*, 21, 74 (1940).

Chromosome Diminution in a Plant

THE genus Sorghum consists of two groups. Eu-Sorghum includes the tetraploid millet species and an octoploid fodder species[1]. Para-Sorghum includes only diploid species ($n = 5$) which are not cultivated. One of these is *S. purpureo-sericeum*, from the Sudan, in which I have described plants with varying numbers of extra chromosomes. These chromosomes I supposed to be inert[2].

I now find from meiosis in the pollen mother cell that, amongst a wild 1931 collection of seeds given me by Mr. C. E. Hubbard of Kew, 40 out of 100 had these extra chromosomes (Table 1).

TABLE 1.

PLANTS WITH *B* CHROMOSOMES IN *Sorghum purpureo-sericeum.*

No. of *B*'s	0	1	2	3	4	5	6	Total
Total plants	60	12	20	5	1	1	1	100
Tested in roots	—	8	7	2	1	1	1	20

Thus there appears to be the same kind of distribution of extra *B* chromosomes in the natural population of this species as occurs in certain cultivated varieties of maize[3]. Again as in maize, these *B* chromosomes do not pair at meiosis with the five ordinary members of the complement. They have, therefore, lost all effective relationship with the active chromosomes, alongside which they must have maintained a separate existence for a great time.

That these chromosomes are in some respects active, and disadvantageously active, is shown by the proportion of healthy pollen (from 500 grains each) in plants having different numbers of *B*'s (Table 2). Their long maintenance in the species therefore demands that they have certain compensating advantages for the plant.

TABLE 2.

EFFECT OF *B*'S ON AVERAGE POLLEN FERTILITY.

No. of *B*'s	0	1	2	3
No. of Plants	6	3	5	2
Good pollen	93·6%	83·6%	63%	11·5%

From mitosis in the root-tips, however, a new and remarkable property of these *B* chromosomes appears. Twenty plants having *B*'s in the pollen mother cells were examined. None had *B*'s in the roots. All had the ordinary chromosome complement of 10 (second line, Table 1).

Re-examination of the flower-tissues of these plants showed the presence of *B*'s at metaphase of mitosis. The resting cells also frequently contained small extra nuclei, which had doubtless arisen from lagging *B*'s. Since these chromosomes are maintained in the tissue, it seems that the extra nuclei must rejoin their companions during mitosis in the flower parts. In the early growth of the roots, on the other hand, they must be lost.

Now irregularities (attributed to a deficient centromere) have often been found in the mitotic movements of extra chromosomes, but never before has a regular loss of such chromosomes been recorded in a particular tissue of a plant. The case at once recalls the well-known *diminution* of chromosomes in Ascaris and, still more forcibly, the exclusion of certain 'sex-limited' chromosomes from the somatic line in Sciara[4].

The further study of these highly controlled chromosomes is therefore likely to throw light on the physiology and mechanics of the more elaborate and more abstruse systems of chromosome diminution found in animals. E. K. JANAKI-AMMAL.

John Innes Horticultural Institution,
Merton Park, London, S.W.19.
Nov. 26.

---

[1] Hunter, A. W. S., *Canad. J. Res.*, 11, 213–241 (1934).

[2] Janaki-Ammal, E. K., *Curr. Sci.*, (1939).

[3] Darlington, C. D., and Upcott, M.B. (1940). *J. Genet.* (in the Press).

[4] Metz, C. W., *Amer. Nat.*, 72, 485–520 (1938).

Compression of Cylinders of Soft Materials

SOME time ago, we proposed an equation[1] to describe the behaviour of soft bodies under compression, with special reference to the compression of cylinders. Whereas for a true fluid we have $\eta = s\sigma^{-1} t^1$, and for an elastic solid $n = s\sigma^{-1} t^0$; we proposed for 'intermediate' materials

$$\psi = s\sigma^{-1} t^k$$

where s is shearing stress, σ is shearing strain calculated by the logarithmic formula, t is time of compression, η is viscosity, n is shear modulus, and ψ was described as the "firmness" and k as "a measure of elasticity", though we should no longer care to use the latter expression, since such properties as work-hardening and dilatancy would reduce k without increasing the elastic recovery.

This equation obviates the difficulties, both practical and theoretical, involved in attempting to divide σ into two parts, recoverable and non-recoverable, in order to calculate η and n for such materials.

In a later paper[2], psychological experiments were described which we believe to justify the use of ψ as a criterion of firmness, in spite of, or rather because of, its peculiar physical dimensions. In neither paper was it possible to give any data to test the equation, nor was it claimed that ψ and k would be expected to be constants for all materials independent of stress and strain conditions. It was, however, hoped that the new treatment would prove simpler than the classical analysis, in which very complex variations in η and n with varying stress and strain conditions and histories are to be found[3].

A direct test of the equation has now been made possible as a result of the design and construction by Dr. P. White and Mr. J. Cotton of an apparatus, to be described shortly, in which cylinders can be loaded in such a way that the load increases proportionally to the change in cross-section of the cylinder, the value of s thus remaining constant throughout the compression.

Under these conditions, the equation may be written:

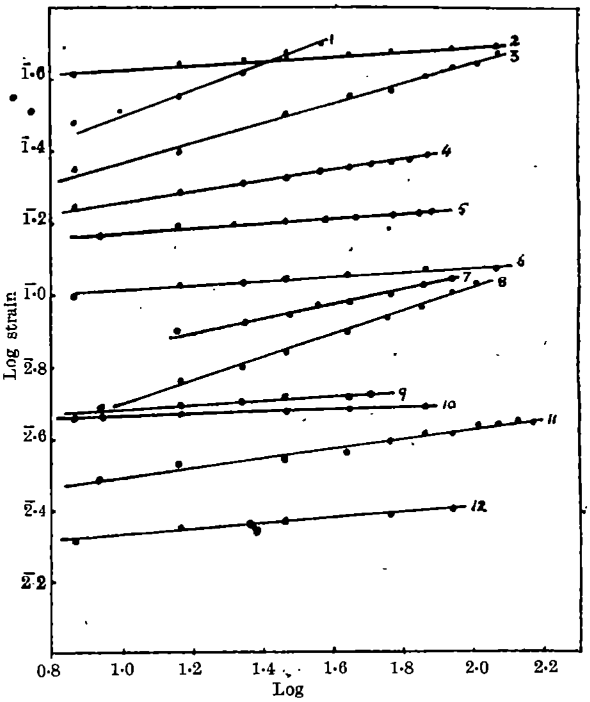
$$\log \psi = k \log t - \log \sigma + \text{const.};$$

or, in the case where the log σ/log t curves are linear:

$$\log \psi = k - \log \sigma_{10} + \text{const.},$$

where σ_{10} is the strain produced in 10 sec.

In view of the principle underlying Fechner's law, it seems not unlikely that 'firmness' as judged subjectively may be related directly to log ψ, and for this reason as well as because the logarithmic values are easier to handle, we prefer to keep the data in the logarithmic form.



No.	Material	Radius	Shearing stress	Log ψ	k
1.	Worked butter	1·5 cm.	58,260 dyne cm.$^{-2}$	5·61	0·35
2.	Wet clay soil	1·0	131,100	5·53	0·035
3.	Rested butter	1·5	58,260	5·67	0·28
4.	Cake	1·0	102,500	5·89	0·14
5.	Acrylic acid polymer	1·0	192,600	6·18	0·06
6.	Mod. wet clay soil	1·0	131,100	6·17	0·055
7.	Cheddar cheese	1·0	131,100	6·47	0·20
8.	Stale bread	1·5	58,260	6·40	0·325
9.	Apple (flesh)	1·0	192,600	6·66	0·055
10.	Potato	1·0	192,600	6·66	0·035
11.	Plasticine-rubber Vaseline mixture	1·0	192,600	6·93	0·14
12.	Dry clay soil	1·0	131,100	6·86	0·07

The new instrument was designed for experiments with cheese and butter, so that the stress range available is somewhat limited, but it has been possible to test, at a constant temperature of 60° F., a number of very varied materials, curves for some of which are shown in the accompanying graph. The log σ/log t curves are remarkably linear, except perhaps at very small strains, where measurements are, in any event, decidedly inaccurate.

Experiments with cylinders of Californian bitumen, which approximates very closely to truly fluid behaviour, indicate that the instrument is compensating correctly for the change in cross-section, unless exceptionally small loads are used. The only case where this error is likely to be just significant is for No. 4, but the curve is shown because of its intrinsic interest.

Our views as to the significance of k have altered in the light of experience with the apparatus. This will be discussed when the experiments are described more fully elsewhere.

G. W. SCOTT BLAIR
F. M. VALDA COPPEN.
National Institute for Research in Dairying,
University of Reading. Nov. 25.

---

[1] Scott Blair, G. W., and Coppen, F. M. V., *Proc. Roy. Soc.*, B, 128, 109 (1939).

[2] Scott Blair, G. W., and Coppen, F. M. V., *Brit. J. Psychol.*, 31, 61 (1940).

[3] Schofield, R. K., and Scott Blair, G. W., *Proc. Roy. Soc.*, A, 138 707, (1932); 139, 557 (1933); 141, 72 (1933); 160, 87 (1937)

AN IRON AGE SETTLEMENT IN SOUTHERN BRITAIN[*]

THE aim of the excavation of the site of Little Woodbury, Wilts, was to uncover the settlement systematically and discover as much about it as possible as a social and economic organism. Little Woodbury being typical, its excavation throws light upon a number of similar sites. Excavations were carried out in the periods June 12–September 18, 1938, and June 12–July 19, 1939. Examination of the site has not yet been completed, but further work has been interrupted by the War.

The settlement lies 1⅓ miles west-south-west of Salisbury Cathedral, on low hills between the Avon and Ebble at about 270 ft. above sea-level. It is situated in a kind of plain of which the highest point is the middle of the site. Four hundred metres to the west is the larger settlement, to which the name of Woodbury has been given. In 1938, 4,500 sq. metres of the site were uncovered, and in 1939 a further 2,500 sq. metres. The traces of prehistoric occupation all belong to Iron Age *A2–AB*, which is regarded as extending over the period from the beginning of the third century B.C. into the first century B.C. The traces of occupation consist of ditches, pits, hollows, and post holes. Finds are few in number, suggesting that the settlers were not numerous, but the nature of the finds shows that the settlement was thoroughly agricultural in character, although the animals' bones indicate that the settlers carried on cattle rearing. There is no sign of industrial activity beyond what was necessary to supply the individual need of each, as for example in weaving. Slag points to the visits of wandering smiths. There is no evidence of any wealth of imported goods.

From the traces of occupation in the form of ditches, pits, hollows, and post holes, of which the examination is described in detail, certain inferences can be drawn. In the area enclosed by the ditches, about a hundred pits have been uncovered up to the present. They vary very much from one to another in form, and some clearly being later than others, obviously were not all in use at one time. In depth they range from 0·49 metres to 2·98 metres. After they had been in use for a time, the pits were filled in, the filling including fragments of chalk, burnt and unburnt flint, ash, potsherds, bones, food refuse, saddle querns and sandstone grinders, iron-slag, smaller objects of everyday use, and cob fragments which had been parts of ovens. From the uses of analogous subterranean receptacles elsewhere and at other times, it is inferred that these pits were used as granaries for the storage of corn, probably roasted previously. The shallower pits may have served to receive receptacles in which water had been stored.

Eleven isolated hollows, in form an irregular quadrangle, with steep or sloping edges and a level floor, were found within the enclosure. In depth they never exceeded a metre, while in size they varied from 10 m. to 24 m. They are dug out on a uniform principle. They were not used for dwelling places, and probably served some purpose in connexion with the harvest, just as in Upper Egypt to-day the women of the villages sit in similar pits to prepare the fruits of the harvest for storage.

The post holes indicate the ground plan of two houses, of which one, the farmstead, shows evidence of reconstruction, and probably represents an advanced stage of development of a primitive prototype in which a circle of huts with lean-to roofs served individual functions belonging to the farmstead. Other post holes, it is inferred, served as drying frames or racks, square granaries, and storehouses.

Each of these elements of the settlement existed over a long period (200–300 years); but while some such pits and work places were short-lived, others, like the houses, were long-lived. No large number of houses existed at the same time. Consequently, the settlement was not a village. Probably there was no more than one dwelling-house at any one time. It follows that this was a farm, with auxiliary buildings necessary for farm work, in which habitation was continuous. No water supply was near, and dependance on water collected from the roof makes it probable that no more than one family occupied the house.

The water deficiency also points to husbandry, rather than cattle farming, as the staple occupation. The open situation of the farm points to peaceful conditions at the time of its erection. The narrow entrance to the palisade precludes the use of carts or the quick driving in of large stocks of cattle, while the decorative gate-building has no military value. Later, however, there was sudden interruption to this state of peace, and it was necessary to provide powerful defences for the farm. The work was never completed, and the palisade again became adequate.

The excavation at Little Woodbury has thrown a flood of light on a large number of other settlements of the same age previously excavated. It is one of a series of farm settlements, not previously recognized as such, which all suffered the same fate and generally enjoyed a uniform civilization. It is calculated that round about twenty acres would represent the land requirements of such a farm, and it is no matter for wonder that these farms should be found lying comparatively close together.

In Woodbury one type only of Iron Age settlement has been established; but its existence presupposes other types. The settlements of the builders of the hill-forts have not yet been determined. Yet the erection of the hill-forts implies a strongly organized and relatively numerous community. Manifestly the people of the farms were too few to have been responsible for them. Their settlements must be sought on the lower slopes in proximity to water to serve both themselves and the relatively large stocks of cattle for which presumably such spacious hill-forts were erected.

All Cannings Cross, Wilts, seems to have been a village on a slope, a situation unusual for this part of the country. Though little of the settlement has been excavated, it is evidently considerably more extensive than the farm. Its inhabitants lived primarily by husbandry.

---

[*] *Proc. Prehist. Soc.*, N.S. 6, 1 (1940). Excavation at Little Woodbury, Wilts.: The Settlement as Revealed by Excavation. By Gerhard Bersu.

The Iron Age *A2–AB* hill forts which were completed when excavated reveal the same civilization as the folk who inhabited other settlements marked by pits. The pits, however, are far too few to suggest that such hill-forts were either constantly inhabited *oppida* or concerned with urban civilization and industry. They were only built and inhabited for a short time during periods of unrest. On the other hand, both boundary ditches and hill-forts lead us to presuppose a substantial agricultural population living outside the farms in open settlements on low ground and on slopes close to water. In such settlements lived the greater part of the agricultural Iron Age *A2–AB* population.

ELECTRIC TUNNEL KILNS FOR FIRING PORCELAIN

IN *Electrotechnics*, the journal of the Electrical Engineering Society of the Indian Institute of Science, Bangalore (S. India), of September, there is published an instructive paper by H. N. Ramachandra Rao, of the Government Porcelain Factory, Bangalore, discussing the use of an electric tunnel kiln for firing porcelain.

Until recently, the discontinuous coal-fired kiln, known as the round kiln, was generally used for firing hard porcelain. This type of kiln has certain inherent defects and demands great skill in handling. The coal used for such a kiln should have a high calorific value and must be free from impurities.

In using these round kilns, the ware is kept in saggars (refractory containers) which prevent the ware from direct contact with the flames, provide for economic filling and keep the ware free from strain. To obtain the maximum temperature of 1,350° C. takes about 36 hours and the kiln has to cool for an additional 48–60 hours before being unloaded.

An important factor that enters into the correct firing of porcelain is the composition of the flue gases. In the round kiln it is very difficult to control the composition of the gases within desired limits on account of the unavoidable contamination or oxidation which takes place owing to the leakage of air into the kiln through combustion devices and holes or cracks that develop in a structure made of brick and fireclay when subjected to repeated heating and cooling. Besides, it is practically impossible to get a uniform distribution of heat inside this type of kiln.

The thermal efficiency of the kiln is very low, about 5–10 per cent, chiefly due to the wastage of heat from the hot gases, which are allowed to escape to the atmosphere at a high temperature. The working cost of such a kiln is again influenced by high labour charges, total holding capacity of the building and high cost of saggars.

These difficulties were to a great extent overcome by the introduction of fuel-fired tunnel kilns which are in more general use at present. There are two types of tunnel-kilns which are suitable for firing hard porcelain. In one type the products of combustion mingle with the ware; the most modern example is the Harrop kiln. The other is of muffled type, and is known as the Dressler kiln. The fuels in general use are natural gas or oil, and they are introduced with a small amount of air through highly refractory burner tubes. The tunnel is provided with a series of fire-places or gas burners on both sides and the goods to be fired are made to enter it on a chain of cars. The hot gases pass along the tunnel towards the end at which the goods enter, so that the ware is gradually heated as it passes towards the hottest part of the kiln. After having attained the maximum temperature required the ware travels on through the remainder of the tunnel, meeting in the journey a current of air travelling in the opposite direction. This air is heated by the cooling goods and gradually attains the maximum temperature of the kiln, thus ensuring the greatest efficiency of combustion. The goods on leaving the tunnel are almost cold.

The tunnel is built almost entirely of brick; low-grade fire bricks are used in the zones of low temperature, and silica or carborundum bricks in the high temperature zone. Suitable expansion joints are provided in the structure. The draught which supports combustion is provided by an exhaust fan.

Although the fuel-fired tunnel kiln is an improvement on the round kiln, it has certain drawbacks which can be eliminated by using the electric tunnel kiln. When the tunnel kiln is fuel-fired, the incoming ware is dependent for its preheating upon the outgoing combustion gases, which heat the upper portions of the ware more than the lower. This not only makes an even rate of preheating over a given cross-section practically impossible, but also limits the rate of preheating to the speed at which the coldest portion becomes sufficiently hot to advance into the high-temperature zone. In the case of an electric tunnel kiln, on the other hand, the absence of moving atmosphere makes an easier recuperation possible in a continuous operation by having two lines of the ware in the same or adjacent tunnels moving in opposite directions. Owing to the greater ease of control in temperature and atmosphere the electric kiln yields first-class ware of a uniformity which cannot be obtained in a fuel-fired kiln. In spite of these advantages the progress made in the use of electricity has been very slow on account of the high cost of electric power. In America especially the general opinion is that electricity cannot compete with such low-priced fuels as oil or natural gas. The use of electricity for heating at low temperature (up to 1,000° C.), for example, in decorating or enamelling kilns was introduced into Switzerland and Germany fifteen years ago.

After extensive research work and experimentation a number of electric tunnel kilns have been installed in Switzerland (since 1933) for the glazing of wall tiles, and for firing fireclay, soft porcelain and other goods requiring temperatures up to 1,300° C. The first kiln for firing hard porcelain was put into operation at the Langenthal Factory in Switzerland in August 1937 and was constructed by Messrs. Brown, Boveri. The main novelty of this kiln, apart from the high temperature of 1,400° C., is that part of the firing is conducted under a reducing oven atmosphere. Above 1,000° C. the heating must be done under reducing conditions, as otherwise the small amounts of iron always present in the raw materials cause a yellowish-brown discoloration with a lowering of the ransparency of the body mixture.

The Langenthal kiln is about 100 metres long ith two tunnels, one for biscuit firing at 900° C. and e other for sharp firing at 1,400° C. The working erience of this kiln shows that apart from the smaller maintenance charges and high percentage of first-class ware obtainable, the savings in saggars is much more than the replacement charges on the elements. The writer concludes by saying that the success of the electric kilns can only be based on a proper combination of electrical engineering and ceramic knowledge.

VIBRATION OF PROPELLER BLADES

EARLY in 1936, at the instigation of the National Physical Laboratory, the Singing ropeller Committee of the Institution of Naval rchitects included among other recommendations its report a proposed research on "the manner in ich typical blades vibrate and the effect on vibra- n characteristics of changes in shape, thickness, ." Some two years later the research was approved the Advisory Committee of the William Froude boratory.

One of the difficulties involved in the discussion vibrating propellers has been the absence of any perimental knowledge of the modes of vibration propeller blades. A few experiments were made y Mr. Harry Hunter, using a shaped flat plate of niform thickness which was set in motion by owing' it. This gave some patterns, but not equencies. Tests with a single propeller blade ving a flat driving surface have recently been hed by Kerr, Shannon and Arnold. As before, [illegible] was held in a vice and vibrated by bowing [illegible] requencies measured by tuning fork and [illegible] re given with their diagrams.

[illegible] adopted to vibrate the blades in the [illegible] ents was devised in conjunction with [illegible] partment of the National Physical [illegible] apparatus being made and the [illegible] carried out by E. J. Evans of that [illegible]

[illegible] llers were one foot in diameter, [illegible] ades on a heavy boss 2·25 in. in [illegible] in. in length. The blades were [illegible] riving face, which was in a hori- [illegible] secured to the base plate by a [illegible] lt and nut. The propeller plates [illegible] he driving face, which was in a [illegible] hen secured to the base plate. [illegible] ting vibration of the blades was [illegible] with its pole tips just above the [illegible] e pole tips were about $\frac{1}{8}$ in. square [illegible] o that the exciting force was applied [illegible] a of the blade. The magnet could [illegible] ntally over the whole surface of one [illegible] supplied with alternating current from [illegible] oscillator and amplifier. The frequency [illegible] varied continuously over a range of about [illegible] 00 cycles per second. In addition to the [illegible] ing current, the magnet was supplied with [illegible] current through a separate pair of coils. In [illegible] s way the magnet produced an alternating field [illegible] known frequency superimposed on a direct field.

To find the resonant frequencies of the propeller, fine sand was sprinkled on the upper surface of the blades, and the exciting current was slowly varied through a given and known range of frequency. The resonance frequencies were detected by the loudness of the note emitted by the propeller, and by the sand on the blades taking a definite pattern, the sand usually moving towards the nodal regions. The magnet was moved about the blade in the tip region until the clearest diagram had been obtained on the blade under the magnet and the most intense note had been found. The frequency was then noted, the magnet removed, its position marked by a black dot, and a photograph of the sand pattern taken. A wide selection of these photographs are used to illustrate the paper.

Since the work was undertaken with a general idea of the results being applied to the problem of the singing propeller, it was desirable to know the range of frequencies which need to be studied for this purpose. The noise (if any) made by a bronze propeller about 18 ft. in diameter, propelling a ship in smooth water, is either a low-pitched hum with beats in it proportional to the number of blades and a frequency varying from 200 cycles per second to a somewhat higher figure; or a grinding noise or grunt with a maximum once per revolution of propeller, the major tone of which may vary from 200 to 300 c.p.s. Either or both of these may be present.

There are two principal modes of vibration which need to be considered, namely, (1) that in which the blade tip as a whole moves perpendicularly to the blade surface, which is referred to as flexural, and (2) that in which the blade twists from the boss about a more or less central line lying on its surface, referred to as torsional. Formulæ for a blade of parabolic outline, obtained by Conn, are given for these two kinds of vibration.

Although the two blades of any propeller were made alike within the normal limits of error for model work, it was found that actually they had slightly different resonant periods. The extreme figures obtained for the two blades for any mode of vibration are given. It is concluded that some of the variations must arise from variations in the metal of the two blades. Torsional and mixed resonance are also discussed and tables of extreme values of cycles per second are given.

A broad comparison of the results obtained with those given by others indicates that most of the patterns obtained by H. Hunter are at too high a frequency to have much bearing on the singing propeller problem. The patterns shown in the paper by Kerr, Shannon and Arnold present some difficulties when compared with those in this paper. Possibly the difference arises from the fact that in these tests the exciting force was continuous and not a single strong burst of vibration. Twenty-five vibration patterns of propeller blades are shown.

HEAT INSULATION IN ELECTRIC POWER STATIONS

HEAT insulation of pipes, boilers and generating sets, which used to be indicated by the general term 'lagging', has now become an art in itself and, to obtain the best results, the material must be graded and applied in a totally different manner for high-, medium- and low-temperature pipe lines and surfaces. In a paper presented at a semi-annual meeting in Milwaukee to the American Society of Mechanical Engineers by Messrs. E. T. Cope and W. F. Kinney, engineers to the Detroit Edison Co., the authors point out that in water-cooled boiler furnaces used in steam generating plants, it is common experience to find that cracks develop in the insulation on water-cooled furnace walls as the result of: (*a*) expansion and contraction of the setting, (*b*) shrinkage of the material, (*c*) settling of the material or (*d*) loosening of the material due to faulty attachment. Because of the likelihood of air infiltration as a result of this situation and to provide a pleasing external appearance, it is frequently considered necessary to encase waterwall furnaces in airtight steel shells, which in turn may require insulation.

Experience has shown that it is virtually impossible to maintain airtight any of the assemblies used in practice unless all-welded steel casings are used, but this is an elaborate and expensive construction and no satisfactory economical method has yet been found. Large areas comprising air-ducts, breechings, fan-housings, tanks and similar equipment are subject to vibration and considerable expansion and contraction. The presence of hot gases varying from perhaps 100° to 600° F. on the inside of the wall with insulation on the exterior is conducive to a great deal of warping and irregular movement, which in turn affects the tightness of the insulation. To provide for this movement, expansion joints are usually installed in various locations on the equipment. It is difficult to retain blocks, blankets, or insulating cement on a surface where so much relative movement and vibration takes place. Unless extreme precautions are taken during the installation, loosening of the insulation will be a recurring problem. Large pipe-bends are still covered with double-layer block insulation, leaving an expansion joint covered with curly glass wool at both ends of each bend.

The selection of thermal insulation for steam turbines is a problem that presented few difficulties in the past, when the operating steam temperatures were well within the temperature limit for asbestos and magnesia products. In recent years the design of steam-generating equipment and turbines has advanced so rapidly in the direction of higher steam temperatures that severe operating conditions are imposed on insulating materials.

Plastic insulating cement has grown in favour because it permits easy application over the irregularities in the turbine shell, but it must be applied in layers, preferably less than 2 in. thick, covered with reinforcing netting secured to lugs on the casing, and trowelled with a finishing cement—a procedure which requires several days to permit adequate drying of each layer on a cold surface. It is questionable whether admitting steam to the turbine to expedite drying of the plastic insulation is an acceptable operating practice, due to the possibility of inducing unequal stresses in the bolts, flanges and appendages.

The advantages of flexibility and low thermal c
ductivity of reinforced open-face flexible insulat
blankets are offset by the widespread objectio
having around the turbine a loose wool that
become detached from its backing, and to the
culty of cutting the metal mesh reinforcement t

Finally the following conclusions, among oth
are reached: (*a*) Insulating pads, composed
textile jacket enclosing a loose filler, appear to be
most desirable form of insulation for turbines. (*b*
determined by extensive field tests, there is
brand of glass fabric pad with glass-wool filler th
preferred for temperatures up to 1,050° F., and t
brands of reinforced white asbestos pads with eit
mineral-wood or amosite asbestos fibre filler are c
sidered reasonably acceptable. (*c*) From act
installations on various sized turbines operating
different steam temperatures from 700° to 910°
it was concluded that 50° F. appears to be a rea
able temperature difference between the ou
surface of the insulation and the ambient air.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments before the dates mentioned:

ASSISTANT MASTER TO TAKE ENGINEERING WORKSHOP PRA
AND ALLIED SUBJECTS in the Willesden Technical College—T
Davies, Education Offices, Dyne Road, Kilburn, London,
(January 15).

LECTURER IN MECHANICAL ENGINEERING—The Registrar, W
don Technical College, Gladstone Road, London, S.W.19.

PRIMARY EDUCATION OFFICER (MALE) for the Education De
ment of the Government of Kenya—The Crown Agents fo
Colonies, 4 Millbank, London, S.W.1 (quoting M/9531).

REPORTS AND OTHE
PUBLICATIONS

(*not include in the monthly Books Supp*

Gr t Britain and Irelar

Ministry of Health: Ministry of Home Secu
of Lord Horder's Committee regarding the
Shelters, with Special Reference to Health
of Action taken by the Government There
(London: H.M. Stationery Office.) 2*d*. ne

Freshwater Biological Association of the
Publication No. 3: The Food of Coarse
Report on the Coarse Fish Investigation.
33. (Ambleside: Freshwater Biological As

The British Academy. Presidential A
Sir David Ross. (From the *Proceedings* of
26). Pp. 8. (London: Oxford University

Other Countri

Commonwealth of Australia: Council f
Research. Fisheries Circular No. 1: Son
of Fish. By E. J. Ferguson Wood. Pp
ment Printer.)

Bulletin of the American Museum of N
Art. 6: The Spiders of Texas, I. By W. J. Ge
307–340. (New York: American Museum of N

Annual Report on the Forest Administrati
Year 1939. Pp. 37. (Lagos: Government Prin
Agents for the Colonies.) 1*s*. 6*d*.

The Cooper Union for the Advancement of Scien
first Annual Report, July 1, 1940. Pp. iii+141.
Cooper Union for the Advancement of Science and

U.S. Department of the Interior: Office of Educatio
Division Bulletin No. 204 (Occupational Information a
Series No. 1): Occupational Information and Guidance;
tion and Administration. With a Brief Survey of the Deve
Guidance and Reports on Present Practices. By Layton S.
Harry A. Jager and Giles M. Ruch. Pp. vii+181. (Washing
Government Printing Office.) 25 cents.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok,
vii. Meteorologiska iakttagelser i Riksgränsen. Pp. 44.
Årsbok, 21, 1939. ii. Nederbörden i Sverige. Pp. 15+1 pla
Meddelanden, No. 32: The Lag-Coefficient of Aerological I
and the Function of Hair Hygrometers at Low Temperatu
Nyberg. Pp. 20. Meddelanden, Band 7, No. 7: Vårflödet i N
vattendrag samt i Dalälven och Klarälven. Av Folke Be
14. 1.50 kr. (Stockholm: P. A. Norstedt and Söner.)